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DEPARTMENT OF THE INTERIOR
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U. S. GEOLOGICAL SURVEY
George Otis Smith, Director

MINERAL RESOURCES
OF THE
UNITED STATES
1923

F. J. KATZ
Geologist in Charge, Division of Mineral Resources

PART II—NONMETALS

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MINERAL RESOURCES OF THE UNITED STATES, 1923—PART II

SULPHUR AND PYRITES

By H. M. Meyer

SULPHUR

GENERAL CONDITIONS

The leading events in the sulphur industry in 1923 were the agreement between the American sulphur producers and the Sicilian Sulphur Consortium, regulating the world's sulphur market, and the entrance into the sulphur industry of a new producing property, at Hoskins Mound, in Brazoria County, Tex., operated by the Freeport Sulphur Co.

The agreement mentioned, which is described in Mineral Resources for 1922, assigns North America to the American producers, Italy to the Sicilian producers, and the remainder of the world proportionately between the two, with the provision that Sicily may sell to any country a maximum of 65,000 tons for the manufacture of sulphuric acid. The agreement permits Sicily to export annually a total of 210,000 tons, including the 65,000 tons for sulphuric acid. It is valid until September 30, 1926, but may be dissolved before that time by not less than six months' notice with the proviso that the dissolution may not occur during the sulphur selling season.

The Texas Co., according to Charles E. Herrman, vice president,[1] while drilling for oil some years ago at Hoskins Mound, encountered rich strata of sulphur at depths ranging from 800 to 1,500 feet. Wells were drilled to prove a minimum of 6,000,000 tons of recoverable sulphur. Not wishing to engage in the sulphur business, the Texas Co. entered into an agreement with the Freeport Sulphur Co. on March 14, 1922, for the development of the deposit. The Texas Co. is to receive an amount corresponding to 50 per cent of the net profits until the Freeport Co. has realized out of the remaining 50 per cent the amount of its investment in the plant, with interest at 6 per cent a year, and thereafter an amount corresponding to 70 per cent of the net profits. The agreement provides that not less than one-half the sulphur sold by the Freeport Co. or any of its affiliated companies during any fiscal period shall be sulphur from Hoskins

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[1] Eng. and Min. Jour.-Press, vol. 115, p. 990, June 2, 1923.

Mound, if sulphur of suitable quality is found there. The Houston & Brazos Valley Railway has been extended to Hoskins Mound, and a plant costing over $2,500,000 has been built.

The Texas Gulf Sulphur Co. has completed a new sulphur-loading plant at Galveston, Tex. The plant consists of two concrete storage bins 600 feet long and 60 feet wide, holding 35,000 tons of crude sulphur, and a series of belt conveyors that carry the material to the top of a tower, whence it is run into the hold of a ship through an aluminum spout. The main conveyor runs the full length of the bins, and on each side of it is a railway track. Two locomotive cranes and a movable hopper straddle the conveyor. The cranes unload the gondolas into the bins and also feed the hopper from the bins. All the machinery is electrically driven. During the initial run of this plant sulphur was loaded at the rate of 540 tons an hour.

The production of sulphur increased from 1,830,942 long tons in 1922 to 2,036,097 tons in 1923, and the shipments increased from 1,343,624 to 1,618,841 tons. Both production and shipments reached new high levels in 1923, the previous records being 1,879,150 long tons produced in 1921 and 1,517,625 long tons shipped in 1920. The estimated value of the sulphur shipped in 1923 is $26,000,000, compared with $22,000,000 for 1922, at approximately the same rate per ton. As usual, the Texas Gulf Sulphur Co. and the Freeport Sulphur Co., of Texas, and the Union Sulphur Co., of Louisiana, produced over 99.9 per cent of the output of sulphur in the United States. Besides these companies, one each in California, Nevada, and Utah contributed to the production of the country.

Stocks, which amounted to nearly 2,500,000 long tons at the end of 1922, increased to nearly 2,900,000 tons at the end of 1923—practically 1.8 times the shipments for the year, so that if production should cease entirely, shipments from stocks could be maintained at the record high rate of 1923 for nearly two years.

Sulphur produced and shipped in the United States, 1917–1923

Year	Produced (long tons)	Shipped	
		Long tons	Approximate value
1917	1,134,412	1,120,378	$23,987,000
1918	1,353,525	1,266,709	27,868,000
1919	1,190,575	678,257	10,252,000
1920	1,255,249	1,517,625	30,000,000
1921	1,879,150	954,344	17,000,000
1922	1,830,942	1,343,624	22,000,000
1923	2,036,097	1,618,841	26,000,000

The chief producing companies are continually investigating new outlets for their product. The following list of uses and industries employing sulphur has been compiled from lists prepared by the research departments of the three large sulphur companies, and though not complete it gives a good idea of the numerous uses to which sulphur and its compounds are put:

Alcohol.
Alum.
Aniline.
Artificial fertilizers.
Artificial silk.
Beltings.
Binders.
Bleaching agent.
Celluloid.
Cements.
Chemicals.
Dyes.
Ebonite.
Elastics.
Explosives.
Fabrics.
Fire extinguisher.
Fireworks.
Food preservatives.
Fumigant.
Fungicide.
Glass.
Glue.
Glycerin.
Illuminant.
Inorganic or organic acids.
Insecticides.
Laboratory reagent.
Leather.
Liquid fuel.
Livestock food.
Lubricants.
Matches.
Medicine.
Metallurgy.
Motor fuels.
Moving-picture films.
Paints.
Paper.
Paper bleaching.
Photography.
Plastics.
Poison.
Refrigerating reagent.
Rodent exterminator.
Rubber hose, tires, and other rubber goods.
Shoe polish.
Soap.
Soda.
Solvent.
Steel pickling and galvanizing.
Storage batteries.
Sugar.
Tanning.
Textiles.
Water purification.

IMPORTS AND EXPORTS [2]

The imports of crude and refined sulphur in 1923 amounted to 1,042,458 pounds, valued at $21,535. The exports of sulphur in 1923 fell to 474,475 long tons, a decrease of 13,494 tons from the exports in 1922. The exports in 1922, however, were the highest ever attained, and those in 1923 were second only to those for 1922 and 1920.

Sulphur exported from the United States, 1917–1923

Year	Long tons	Value
1917	152, 736	$3, 500, 819
1918	131, 092	3, 626, 638
1919	224, 712	6, 325, 552
1920	477, 450	8, 994, 350
1921	285, 762	$4, 524, 768
1922	487, 969	7, 209, 357
1923	474, 475	7, 216, 107

Although the customs districts from which crude sulphur was cleared in 1923 are distributed around the entire border of the country, practically all the sulphur exported was produced by the large mines in Texas and Louisiana.

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[2] Statistics of imports and exports have been compiled by J. A. Dorsey, of the U. S. Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

Sulphur exported from the United States in 1923, by destination

Destination	Sulphur (crude)		Refined and sublimed sulphur and flowers of sulphur	
	Long tons	Value	Pounds	Value
North America:				
Canada	127,971	$1,974,110	1,716,301	$40,279
Mexico	11,341	162,897	1,365,370	27,457
Newfoundland and Labrador			2,725	137
	139,312	2,137,007	3,084,396	67,873
Central America and the West Indies:				
Cuba	6,623	93,474	59,456	2,929
Guatemala	11	782	66,041	1,655
Nicaragua	2,504	35,255	115,069	3,382
West Indies and Bermudas	17	824	56,579	2,034
Other	86	3,608	62,751	2,706
	9,241	133,943	359,896	12,706
South America:				
Argentina	2,550	39,052	40,125	2,942
Brazil	2,430	52,784	4,940	145
Colombia	26	1,181	63,556	3,215
Other	54	2,183	96,324	3,489
	5,060	95,200	204,945	9,791
Europe:				
Belgium	10,800	151,200		
England	29,953	469,586	10,857	1,308
France	98,827	1,443,112		
Germany	83,821	1,328,288		
Netherlands	8,555	119,970		
Norway	544	7,616		
Spain	11,192	164,120		
Other Europe	850	11,900		
	244,542	3,695,792	10,857	1,308
Asia and Oceania:				
Australia	50,530	709,538	584,059	16,067
New Zealand	10,750	150,500	105,560	2,524
Other	1,340	17,880	17,248	528
	62,620	877,918	706,867	19,119
Africa:				
Algeria and Tunis	7,600	114,400		
British South Africa	4,150	51,000		
British West Africa			129	50
	11,750	165,400	129	50
	472,525	7,105,260	4,367,090	110,847

European countries, headed by France, Germany, England, and Spain, received 52 per cent of the crude sulphur exported from the United States in 1923, compared with 60 per cent in 1922. Canada received 27 per cent, compared with 22 per cent in 1922, which was the largest amount shipped to any one country. Australia received the only other large amount, approximately 11 per cent. Exports to Canada increased from 107,974 long tons in 1922 to 127,971 tons in 1923; to France from 93,168 to 98,827 tons; to Germany from 63,164 to 83,821 tons; to Australia from 48,825 to 50,530 tons; to Belgium from 5,012 to 10,800 tons; and those to England decreased from 38,068 to 29,953 tons. There were no exports to Sweden in 1923, although 41,325 long tons of sulphur was exported to that country in 1922.

Consul General D. I. Murphy,[3] Stockholm, reported January 18, 1923, that investigation of the recently discovered ore deposits of the Province of Vasterbotten, Sweden, disclosed three forms of "sulphur pyrite ores," as well as a "combined zinc and sulphur ore." He quotes the Svenska Dagbladt in reference to these discoveries as follows:

> As the demand for such ores is great, the new fields will be of much interest to the sulphite cellulose industry in Norrland, which, owing to these finds, can fill its requirements without having to obtain sulphur from Norway and the United States. (Official American records show exports from the United States to Sweden of 41,325 long tons of sulphur in 1922.) It will doubtless be possible to obtain from 100,000 to 150,000 tons of sulphur from these mines—an amount about equal to that now imported. The richest ores have been found in the neighborhood of Bjurfors, but the fields extend from Skelleftea to Stensele.

Of the refined and sublimed sulphur and flowers of sulphur only negligible quantities went to Europe. North American countries, chiefly Canada and Mexico, received 3,084,396 pounds out of a total quantity exported of 4,367,090 pounds. The average value of the sulphur exported in 1923 was $15.04 a long ton, compared with $14.61 in 1922.

PYRITES

DOMESTIC PRODUCTION

There was no improvement in the market for domestic pyrites in 1923, practically the same conditions that have dominated the market for several years being prevalent. Only those companies whose properties are well situated and had been developed and which had been producing for years were able to produce in 1923. Pyrites produced in the United States apparently can not compete under normal conditions with domestic sulphur and Spanish pyrite. There was a slight increase in production, from 169,043 long tons in 1922 to 181,628 long tons in 1923, but the value decreased from $671,241 to $661,000. Of the quantity produced 170,997 long tons was either sold or consumed by the producing companies. Pyrites was produced in five States in 1923—California, New York, Ohio, Virginia, and Wisconsin. The combined production of California and Virginia was 170,300 long tons; New York produced 11,000 tons, Ohio 138 tons, and Wisconsin 190 tons. The mine of the Connecting Link Mining Co., in Wisconsin, was operated only five months in 1923, as the mill was destroyed by fire the first of June.

Pyrites produced in the United States, 1917–1923

Year	Long tons	Value
1917	482, 662	$2, 593, 035
1918	464, 494	2, 644, 515
1919	420, 647	2, 558, 172
1920	310, 777	1, 596, 961
1921	157, 118	$711, 432
1922	169, 043	671, 241
1923	181, 628	661, 000

The total sulphur content of lump and fines produced in 1923 was equivalent to 74,965 long tons, which would indicate an average content of 41 per cent.

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[3] Commerce Repts., Feb. 26, 1923, p. 556.

IMPORTS

The imports of pyrites decreased from 279,445 long tons in 1922 to 263,695 long tons in 1923. The imports for 1923 were, with the exception of those for 1921, the smallest since 1898. The record for imports was made in 1916, when 1,244,662 long tons was imported.

Sulphur ore as pyrites, containing more than 25 per cent of sulphur, imported for consumption, 1917–1923

Year	Long tons	Value	Year	Long tons	Value
1917	967, 340	$5, 981, 457	1921	216, 229	$818, 852
1918	496, 792	2, 741, 676	1922	279, 445	1, 199, 076
1919	388, 973	2, 176, 565	1923	263, 695	1, 254, 389
1920	332, 606	1, 660, 832			

Sulphur ore as pyrites, containing more than 25 per cent of sulphur, imported for consumption in 1923, by countries and districts of entry

Country	Long tons	Value	District of entry	Long tons	Value
Belgium	390	$1, 245	San Francisco	390	$1, 245
Canada	10, 443	34, 160	Buffalo	10, 443	34, 160
France	(a)	9	San Francisco	(a)	9
Italy	(a)	7	Porto Rico	(a)	7
Spain	252, 862	1, 218, 968	New York	46, 078	314, 063
			Philadelphia	94, 549	438, 159
			Maryland	81, 094	350, 533
			South Carolina	10, 801	28, 306
			Virginia	9, 215	50, 384
			Georgia	11, 125	37, 523
	263, 695	1, 254, 389		263, 695	1, 254, 389

[a] Quantity not reported.

MAGNESIUM AND ITS COMPOUNDS[1]

By J. M. Hill and G. F. Loughlin

INTRODUCTION

For many years magnesite, the normal carbonate of magnesium, and dolomite, or high-magnesium limestone, were the only commercial sources of magnesian products in the United States, and their uses were sufficiently distinct for magnesite to be treated in a separate chapter of Mineral Resources and for dolomite to be included with limestone in the chapter on stone. Domestic magnesite, though a potential source of several products that were marketed chiefly east of Mississippi River, could not compete with foreign magnesite. During the World War, however, domestic magnesite and dolomite were both exploited to relieve the shortage caused by the curtailment of imports. Imports of magnesium chloride and sulphate and of metallic magnesium were also restricted, and this condition has led to the exploitation of domestic deposits and processes of manufacture. For these reasons it has been suggested that the annual review of magnesium and its natural and manufactured compounds be given in one chapter. The natural compounds include magnesite, dolomite, magnesium chloride, and magnesium sulphate. The manufactured compounds include the basic (or "technical") carbonate, calcined and dead-burned magnesite, dead-burned dolomite, and precipitated carbonate and sulphate derived from magnesite or dolomite, or from the crude sulphate.

Only the quantity of dolomite produced for its magnesium content is included here. Much larger quantities, either burned into lime or used as dimension, crushed, or pulverized stone, are included in the corresponding chapters on lime and stone.

The uses to which magnesite has been or may be put, for most of which dolomite is also used, are as follows:[2]

In the manufacture of carbon dioxide and the sulphite process of paper manufacturing, in both of which magnesite has been displaced by cheaper dolomite or limestone; for refractory brick, shapes, crucibles, and furnace hearths, for which both dead-burned magnesite and dead-burned dolomite are used; for medicinal and toilet preparations, which are made from magnesite, dolomite, and natural magnesium sulphate; for pipe covering (mixed with asbestos), which in this country is probably all made from dolomite; for oxychloride

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[1] Figures of imports and exports compiled from the records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, of the U. S. Geological Survey.

[2] These uses are reviewed in detail in U. S. Geol. Survey Bull. 355, 1908, and brief comments on magnesium chloride, sulphate, basic carbonate, metallic magnesium, and their uses are made in the chapter on magnesite in Mineral Resources of the United States for 1914, pp. 573–577.

(Sorel) cement, which is made from a mixture of calcined magnesite and magnesium chloride; as an absorbent in the manufacture of dynamite, a preventive of boiler scale where sulphurous waters are used, an accelerator in the vulcanization of rubber, fused magnesia for insulation at exceedingly high temperatures, and an adulterant of paint, all of which presumably call for calcined magnesite but are relatively unimportant in the consumption of domestic magnesite; and for metallic magnesium, which is made both from calcined magnesite and from magnesium chloride.

The section on magnesite has been prepared by Mr. Hill, and the other sections by Mr. Loughlin.

MAGNESITE

DOMESTIC PRODUCTION

In 1923 mines in the United States sold calcined magnesite equivalent to 147,250 short tons of crude magnesite, valued at $1,103,700, an increase of 164 per cent in quantity but of only 93 per cent in value, as compared with the output in 1922. The increase in value reported for 1923 is relatively small because it is determined by prices f. o. b. shipping points, and the operators in the State of Washington place a very low price on crude magnesite. The production in 1923 was about equal in California and Washington. Most of the product in California was sold as caustic calcined magnesite, and most of that in Washington was sold dead-burned.

Seven producers in California in 1923 operated at 11 localities in 6 counties. In Washington 3 companies produced crude magnesite from deposits near Valley and Chewelah, in Stevens County.

Crude magnesite sold or treated in the United States, 1918–1923

Year	Short tons	Value	Year	Short tons	Value
1918	231, 605	$1, 812, 601	1921	47, 904	$510, 177
1919	156, 226	1, 248, 415	1922	55, 790	571, 745
1920	303, 767	2, 748, 150	1923	147, 250	1, 103, 700

Of the domestic magnesite and its products sold in 1923 only 6,020 tons (9 per cent) was sold crude, for use largely in making chemicals; 28,470 tons (41 per cent) was sold as caustic calcined magnesite, for use as plastic material; and 34,410 tons (50 per cent) was sold dead-burned, for use as a refractory. These figures show that the material actually sold in 1923 amounted to 68,900 tons, which computed as crude magnesite would amount to 147,250 tons, for it takes 2 to 2½ tons of crude magnesite to make 1 ton of caustic calcined or dead-burned magnesite.

At the end of the year producers reported that 14,520 tons of crude magnesite was in stock on dumps, exclusive of large quantities of fines held at several dumps to be calcined eventually.

IMPORTS AND EXPORTS

Magnesite, not purified, imported into the United States, 1921–1923, by countries, in short tons

[General imports]

Country	1921	1922	1923
Austria	9,496	----------	1,675
Belgium	----------	50	101
Canada	427	973	427
Czechoslovakia	213	7,781	----------
England	8	59	162
Germany	3,884	20,074	162
Greece	4,480	1,120	5,510
India, British	28	3,297	7,576
Italy	36,121	94,930	65,262
Netherlands	2,914	5,379	4,406
Poland and Danzig	----------	----------	1
Rumania	----------	----------	24
Scotland	90	595	729
Venezuela	1,120	----------	----------
	58,781	134,258	86,035

Magnesite imported for consumption in the United States, 1919–1923

Year	Crude		Calcined, not purified	
	Short tons	Value	Short tons	Value
1919	6,381	$103,311	9,471	$270,721
1920	33,550	406,204	14,780	373,165
1921	51,993	525,452	6,788	250,932
1922	73,331	976,283	72,265	1,267,622
1923	5,182	44,081	72,955	1,022,968

So far as known, Belgium, Germany, and the Netherlands produce no magnesite, the material shipped from those countries being mined in Austria and Czechoslovakia. A large part of the magnesite imported from Italy probably also comes from Czechoslovakia. With the resumption of activity in the steel industry the imports of magnesite have increased, because a large part of the imported material is dead-burned and is consumed at steel-making plants near the eastern seaboard. There was a great decrease in the imports from Germany. Most of the magnesite imported from India is the caustic calcined product in lumps, but the caustic calcined magnesite received from Greece is ground.

The calcined magnesite imported for domestic consumption in 1923 was valued at $14.02 a short ton, but the price was evidently fixed at the points of shipment in the producing country, for the fact was brought out in the hearing before the Tariff Commission on December 5, 1923, that the cost of magnesite imported from India in the form of calcined lump delivered at New York is $37.89.

Of the calcined magnesite imported in 1923 11,229 short tons was imported as caustic calcined, which was valued at $315,585 ($28.10 a ton), and 61,726 tons as dead-burned, valued at $707,383 ($11.46 a ton). The value is evidently fixed at the port of export.

No exports of magnesite, either crude or calcined, were reported during 1923, but materials made of magnesia (including pipe and boiler coverings), having a weight of 5,391,219 pounds and valued at $337,044, were exported.

ANNUAL SUPPLY

The annual additions to supply of magnesite (which have been called consumption, although they do not include stocks held at consuming plants) consist of domestic production plus imports, for there are no exports of crude or calcined magnesite. The following table shows that the domestic producers have increased their contribution to the consumption by the aid of the tariff act of 1922.

Magnesite supply in the United States, 1918–1923, expressed as crude magnesite, in short tons

Year	Domestic production	Imports	Total	Percentage supplied by—	
				Domestic	Foreign
1918	231, 605	43, 530	275, 135	84	16
1919	156, 226	25, 321	181, 547	86	14
1920	303, 767	63, 110	366, 877	83	17
1921	47, 904	65, 569	113, 473	42	58
1922	55, 790	217, 861	273, 651	26	74
923	147, 250	151, 092	298, 342	49	51

CAUSTIC CALCINED MAGNESITE

The caustic calcined magnesite sold in 1923 amounted to 28,470 short tons (equal to about 64,000 tons of crude), of which mines in California produced 95 per cent. The largest producers of caustic calcined magnesite were C. S. Maltby, the Sierra Magnesite Co., and Harker & Hoff, of California, and the American Mineral Products Co., of Washington. During 1923 the Bureau of Standards[3] made tests of caustic magnesia made of magnesite mined at several places and found that (1) the magnesite from different localities should be burned under different conditions; (2) very light calcination produces a magnesia too active for present practice; (3) an oxide should not be condemned because it will not work in a set formula; (4) the character of the aggregate may affect the action of the magnesia; (5) different oxides are required for flooring and for stucco; (6) the character of the magnesia determines in large part its resistance to moisture, but the effect of the "mix" predominates; (7) the character of the magnesia predominates over the "mix" in effecting changes in volume.

Calcined magnesite and light magnesium carbonate (chemically prepared) are used in making rubber tires, and a fellowship has been established at the Mellon Institute for further study of this subject.[4]

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[3] Bates, P. H., Young, R. N., and Rapp, P., Tests of caustic magnesia made from magnesite from several localities: U. S. Bur. Standards Tech. Paper 239, 1923.

[4] Wikoff, A. G., Some research of general interest in progress at the Mellon Institute: Chem. and Met. Eng., vol. 28, pp. 629–630, Apr. 9, 1923.

DEAD-BURNED MAGNESITE

The dead-burned magnesite sold in the United States in 1923 amounted to 34,410 short tons, equivalent to 77,230 tons of crude, as compared with less than 2,500 tons in 1922. About 90 per cent of the dead-burned output was produced in Washington, but some was produced in Napa and San Benito counties, Calif. Dead-burned magnesite is used as a refractory, particularly in the iron industry, and most of it finds a market east of the Mississippi. Only by the aid of adequate tariff protection can domestic producers compete in the East with foreign competitors.

CRUDE MAGNESITE

In 1923 the quantity of magnesite sold crude by the producers was only 6,020 tons, more than half of which was later caustic calcined for use as plaster. Most of the remainder was used by makers of magnesia chemicals, only a very small quantity having been used by makers of high-grade refractory products. Information concerning magnesia chemicals is given on pages 17–18.

During the last few years very high grade refractories have been made in small quantities in the electric furnace by fusing magnesite. This product is made by the Carborundum Co.[5] and also by the Vitrefrax Co.,[6] which reports that it has a density of 3.67 to 3.69, is the most refractory commercial material known, and has a melting point of 2,800° C. (5,072° F.). It is strongly basic, shows no shrinkage, and is particularly valuable in high-temperature electric-furnace work.

A much smaller quantity of carefully selected magnesite is sold each year for the manufacture of metallic magnesium.

MARKET AND PRICES

The domestic market for magnesite of all grades was much improved in 1923 as compared with 1922, but producers still insist that they can not compete in the East with foreign magnesite. The caustic calcined magnesite from India and from Greece can be sold cheaper than domestic material of equal grade.[7] A recent report of the Department of Commerce [8] gives information concerning the foreign and domestic supply of magnesite and the markets for it.

Domestic crude magnesite was quoted [9] at $14 a ton during the first four months of 1923, at $12.50 during the period May to August, and at $14 from the 1st of August to the end of the year. Operators reported sales at $10 to $14, but most of the crude magnesite sold brought $13 a ton. So far as known, no imported crude magnesite was offered in the local markets in 1923.

Domestic caustic calcined magnesite was quoted [9] at $40 a ton f. o. b. plants in California until late in March, when the quotations declined to $32.50 to $35; they remained at that level until the 1st of August, when they were raised to $35 to $37 a ton. Producers reported sales of domestic caustic calcined magnesite at prices ranging from $32 to $40 a ton, but the bulk of the output sold at about $35 a ton. Magnesite from Greece was quoted only after March, 1923, and the price was $50 to $52 a ton delivered.

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[5] Chem. and Met. Eng., vol. 28, p. 635, Apr. 9, 1923.

[6] See booklet entitled "The irreducible volume," p. 13.

[7] Hearings before the Tariff Commission, Dec. 5, 1923.

[8] Trade Information Bull. 184, Magnesite, 1924.

[9] Eng. and Min. Jour.-Press, vols. 115 and 116, 1923.

Domestic dead-burned magnesite was quoted[9] at $40 to $48 a ton delivered in sacks at Baltimore, Md., or Chester, Pa., and at $32 to $34 a ton in bulk at shipping points in the State of Washington. Producers reported the bulk of sales at $16 to $37 a ton at the plant.

Average value per short ton of domestic and imported magnesite, 1918–1923

Year	Domestic		Imported [a]	
	Crude	Caustic calcined	Crude	Caustic calcined
1918	$7.83	$32.00	$19.00	$43.26
1919	7.99	32.00	16.19	28.58
1920	9.05	----------	12.11	25.25
1921	10.65	32.00	10.11	36.97
1922	10.25	37.00	13.31	17.54
1923	13.00	36.38	8.51	14.02

[a] Value at point of origin as declared on manifest.

The companies in California and Washington named below produced magnesite in 1923. Most of them sell the calcined products, though some crude can possibly be had from any of them.

California:
- California Magnesia Co. (Harker & Hoff), 333 Monadnock Building, San Francisco.
- California Magnesite Co., 1215 First National Bank Building, San Francisco.
- E. C. Ferguson, Piedra.
- A. J. Jackson, jr., Morgan Hill.
- C. S. Maltby, Humboldt Bank Building, San Francisco.
- Sierra Magnesite Co., 404 Balfour Building, San Francisco.
- Vail & Maxwell, 820 Syndicate Building, Oakland.

Washington:
- American Mineral Products Co., Valley. (Sold in 1923 to Northwest Magnesite Co.)
- Double Eagle Mining Co., Valley.
- Northwest Magnesite Co., Crocker Building, San Francisco, Calif.

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[9] Eng. and Min. Jour.-Press, vols. 115 and 116, 1923.

WORLD'S PRODUCTION

World's production of magnesite in 1915–1922, by countries, in metric tons

[Unless otherwise stated the quantities in this table represent crude magnesite mined]

Country	1915	1916	1917	1918	1919	1920	1921	1922
Australia:								
New South Wales	843	3, 821	9, 337	3, 419	9, 413	6, 578	12, 465	3, 424
South Australia	81	169	152	447	277	188	175	585
Victoria	192	30	75	229	78	153	130	99
Western Australia	612	100	21	107	---------	---------	---------	---------
Austria-Hungary	[a] 78, 314	[a] 81, 771	[a] 106, 783	([b])	([c])	[d] 120, 347	[d] 160, 823	[e] 427, 556
British India	7, 569	17, 922	18, 493	5, 947	17, 401	14, 577	20, 338	19, 582
Canada	16, 475	51, 981	58, 755	52, 434	13, 564	28, 159	8, 447	7, 899
Cyprus	15	15	([b])	([b])	([b])	([b])	([b])	895
Greece	159, 981	199, 484	162, 938	39, 340	62, 408	71, 870	60, 132	55, 471
Italy	9, 200	18, 252	31, 070	28, 882	35, 930	33, 850	9, 410	3, 300
Norway [f]	[a] 4, 017	[a] 3, 499	[a] 1, 004	[a] 542	[a] 1, 882	[a] 2, 041	[a] 210	[g] 738
Russia	([b])	72, 074	73, 712	19, 656	([b])	17, 984	[h] 8, 340	10, 567
Spain	1, 400	2, 500	800	1, 700	120	1, 214	---------	303
Union of South Africa	569	553	709	756	929	1, 287	1, 317	962
United States (sold or treated)	27, 668	140, 589	287, 429	210, 107	141, 725	275, 571	43, 458	50, 612
Venezuela (exports)	([b])	6, 360	1, 700	([b])	([b])	2, 000	2, 450	([b])

[a] Exports computed on a basis of 2.1 tons crude to 1 ton sintered.

[b] No data available.

[c] Exports from the Republic of Austria for second half of 1919, 8,523 tons crude and 24,268 tons dead-burned (sintered).

[d] Exports from Republic of Austria computed on a basis of 2.1 tons crude to 1 ton sintered. In addition, 7,026 tons of caustic magnesia was exported in 1920, and 8,252 tons in 1921.

[e] Production of crude magnesite in the present Republic of Austria.

[f] In addition there was exported magnesite brick (magnesittegel) as follows: 1915, 729 tons; 1916, 519 tons; 1917, 341 tons; 1918, 355 tons; 1919, 357 tons; 1920, 710 tons; 1921, 337 tons.

[g] Production of crude magnesite. Prior to 1922 only figures of exports available.

[h] Production computed on basis of 2.1 tons crude to 1 ton sintered.

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NOTES ON THE MAGNESITE INDUSTRY

DOMESTIC INDUSTRY

California.—The Sample property, near Piedra, Fresno County, Calif., was operated for a time early in the year. C. S. Maltby produced dead-burned magnesite at the White Rock deposit, near Rutherford, Napa County, until the end of May, when the mine was abandoned and the equipment moved to the old Tulare (Nichellini) deposit, in Chiles Valley, which Maltby has under lease. A 4 by 56 foot oil-fired rotary kiln was also installed, which produced dead-burned magnesite. No magnesite was mined in 1923 from the deposits near Alta and Towle, in Placer County. In San Benito County, at the Sampson mine, under lease to C. S. Maltby, a 7 by

80 foot oil-fired rotary kiln was installed, and a large tonnage of dead-burned and caustic magnesite was shipped. It is reported that the Standard mine, at Sampson Peak, owned by Hugo Fischel, is to be reopened by the Superior Magnesite Co. No operations were reported at the magnesite deposits near Cima or Yermo, in San Bernardino County, though it is rumored that the Master Products Co., of Los Angeles, will open a deposit in the southern part of the State.

The largest production of magnesite in California was made at the Red Mountain mine, near Livermore, Santa Clara County, operated by C. S. Maltby. The roasting equipment[10] consists of four upright kilns for burning lump ore and a Scott furnace for handling fines. The ore is crushed to three-fourths inch in size. Pyrometer control of furnace heat at 2,100° F. is used on the Scott furnace. It is reported that there is a large reserve of fines on the dump of this property, which will some day be calcined. A little crude magnesite was shipped from deposits near Morgan Hill, in Santa Clara County.

No magnesite was produced in 1923 in Sonoma County, but the Granitite Manufacturing Co., of San Diego, took over the old Sonoma mine, near Guerneville, and expects to ship crude magnesite to a calcining plant in San Diego by the middle of 1924.

A little ore was mined near Gustine, Stanislaus County, but none was shipped. The California Magnesite Co. operated its property on the southeast side of Red Mountain, near Patterson, until June. The property is equipped with a one-stack kiln and a small rotary for fines. The calcined product is shipped to Los Angeles for grinding.

The Sierra Magnesite Co., the second largest producer of magnesite in California, operated the Rex, Lindsay, and Tulare mines, near Lindsay and Magnesite, Tulare County, and did considerable development work on the Gill ranch, at the north end of Porterville Hill.[11] Crude magnesite is calcined at a well-equipped plant at Porterville in rotary furnaces with pyrometer control. The grades of caustic magnesite produced are made and sold under rigid specifications. Harker & Hoff, organized as the California Magnesia Co., operated the Porterville Hill mines and produced caustic calcined magnesite in a vertical kiln on the ground. The large rotary furnace at the plant was not used in 1923. No magnesite was mined from the deposits near Exeter.

In Tuolumne County the Gray Eagle mine was leased in 1923 by Vail & Maxwell, who installed a 12-ton vertical kiln at Chinese Camp during the year and produced caustic calcined magnesite.

Nevada.—No magnesite was mined in 1923 from the magnesite deposits in Clark County, Nev., which are said to be controlled by Frank Hudson, of San Francisco. It is rumored that the deposits will be worked in 1924.

Washington.—The Northwest Magnesite Co., operating the Finch, Keystone, and Midnight deposits, near Chewelah, Stevens County, Wash., is the largest producer of magnesite in the State and in 1923 mined more crude magnesite than any other company in the country. All of its output is dead-burned in six electrically controlled rotary kilns and is used by the steel interests for refractory products. It is reported that many improvements were installed in both the mining and the calcining departments, but production during the summer was continued at about 50 per cent of capacity and later at 15 per cent of capacity, as the company reported that it could not compete in price with imported Austrian dead-burned magnesite in the large consuming centers—the pig-iron districts of Illinois, Ohio, and Pennsylvania. In December it was announced that the Northwest Magnesite Co. had purchased the Red Marble, Allen, Moss, and Woodbury magnesite mines, at Valley, formerly owned and operated by the American Mineral Products Co., which sold both dead-burned and caustic calcined magnesite in 1923. A small amount of magnesite was mined at the Double Eagle, near Valley, and used for plastic products.

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[10] California State Min. Bur. Twentieth Ann. Rept., pt. 1, p. 30, 1924.

[11] Idem, pp. 30–31.

FOREIGN INDUSTRY

Considerable information on the magnesite industry in foreign countries is given in Trade Information Bulletin 184 of the Bureau of Foreign and Domestic Commerce, issued February 4, 1924.

Bain[12] has described the magnesite deposits of Grenville, Quebec, as occurring near the crest of a plunging anticline near serpentine veins in limestone, which has been recrystallized and in part dolomitized.

It is reported[13] that the Krupp Co., of Germany, has made a 10-year contract with the Styrian Magnesite Co. to supply 75 per cent of the requirements of the Krupp Co., which will take practically the whole output of this Austrian concern.

Apparently the American-owned deposits of magnesite on the island of Margarita, off Venezuela, were not worked in 1923, for no magnesite was sent from them to the United States.

DOLOMITE

DOLOMITE PRODUCTS

Dolomite sold for uses that are or have been also supplied by magnesite increased 14 per cent in quantity in 1923, but was 22 per cent below the record quantity of 1920. The approximate quantity of crude dolomite used in the manufacture of these products is as follows:

Crude dolomite sold in the United States for certain uses, 1918–1923, in short tons

[Uses include dead-burned dolomite, basic magnesium carbonate, sulphite process of paper manufacture, and making of carbon dioxide]

1918	1,413,000	1921	499,000
1919	947,000	1922	1,074,000
1920	1,580,000	1923	1,226,000

DEAD-BURNED DOLOMITE

The principal dolomite product included in the category of dead-burned dolomite is that for refractory use. Some manufacturers of this product buy their stone, the sales of which are reported to the United States Geological Survey by the quarry companies in terms of crude stone; others quarry their own stone and report only in terms of dead-burned material. The two kinds of material are represented in the accompanying table, as well as the estimated total output in terms of dead-burned dolomite. The substantial increase in output in 1923, when the domestic output and imports of dead-burned magnesite also increased, is noteworthy, as industrial conditions were then more nearly normal than in any other year since dead-burned dolomite has been of commercial importance.

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[12] Bain, G. W., Magnesite deposits of Grenville, Quebec: Am. Inst. Min. and Met. Eng. Trans., No. 1244 M, May, 1923.

[13] Min. Jour. (London), vol. 140, p. 114, Feb. 10, 1923.

Dead-burned dolomite sold or used in the United States, 1918–1923

Year	Reported as raw stone		Reported as dead-burned		Total quantity calculated as dead-burned (short tons)
	Short tons	Value	Short tons	Value	
1918	490,863	$560,209	318,896	$4,097,819	564,000
1919	254,787	394,754	222,036	2,228,602	349,000
1920	612,800	742,020	316,293	3,732,522	623,000
1921	79,480	85,786	107,664	1,113,010	147,000
1922	146,640	172,251	348,838	2,813,946	422,200
1923	205,890	249,993	357,642	3,599,116	460,600

BASIC MAGNESIUM CARBONATE

Basic magnesium carbonate, or "technical carbonate," used in "85 per cent magnesia" pipe and boiler coverings also increased substantially in output in 1923. Most manufacturers of this product buy their stone and do not report their output to the United States Geological Survey; but the crude stone sold for this purpose has been reported as follows:

Dolomite sold in the United States to magnesia works for manufacture of basic magnesium carbonate, 1918–1923

Year	Short tons	Value	Year	Short tons	Value
1918	90,989	$126,255	1921	32,050	$60,648
1919	62,652	82,619	1922	53,170	79,313
1920	57,300	107,107	1923	116,410	146,337

HIGH-MAGNESIUM LIME FOR SULPHITE PAPER MILLS

An estimate of the high-magnesium lime sold to sulphite paper mills is given below. Exact figures are impossible to obtain, as many lime producers who sell burned lime to paper mills do not specify the kind of paper mill. The quantity sold is expressed as burned lime.

High-magnesium lime sold in the United States to sulphite paper mills, 1918–1923

Year	Short tons	Value	Year	Short tons	Value
1918	88,631	$726,610	1921	68,992	$711,345
1919	83,962	632,930	1922	70,000	650,000
1920	121,817	1,347,321	1923	75,000	750,000

CARBON DIOXIDE

Sales of crude dolomite for the manufacture of carbon dioxide, chiefly in California and also in North Carolina, are as follows:

Dolomite sold in the United States for the manufacture of carbon dioxide, 1918–1923

Year	Short tons	Value	Year	Short tons	Value
1918	16,770	$22,500	1921	34,090	$124,984
1919	16,870	39,895	1922	38,280	58,748
1920	33,040	73,671	1923	38,460	52,494

MAGNESIUM CHLORIDE

Magnesium chloride from bittern waters of salt works was produced and sold by four companies in 1923—three in California and one in Michigan. There were no shipments from Utah. Not all these companies reported their sales to the United States Geological Survey, but the total quantity sold is roughly estimated at 28,000,000 pounds. Most of this material was sold as "commercial" crystallized chloride, 97 per cent or more pure; but several thousand gallons of solution was also sold.

Imports of magnesium chloride more than doubled in 1923. Of the total recorded in the table below 56,110 pounds was anhydrous chloride, valued at $2,703, and the remainder was "not specially provided for." The large increase in imports over those of 1922 reflects the continued growth in the manufacture of magnesium oxychloride or Sorel cement.

Magnesium chloride imported for consumption in the United States, 1918–1923

Year	Pounds	Value	
		Total	Average
1918 (July–December) [a]	13,076	$1,619	$0.124
1919	11,200	538	.048
1920	454,334	7,098	.016
1921	7,365,812	85,727	.012
1922	11,403,837	113,618	.010
1923	23,052,385	190,748	.008

[a] Not separately classified prior to July 1, 1918.

MAGNESIUM SULPHATE

Natural magnesium sulphate was produced in 1923 from a dry lake deposit near Oroville, Wash., and from bittern waters of salt works in California and Michigan. Three of the four producers reported sales in 1923, and the total quantity sold is estimated at 14,300,000 pounds, valued at $231,000.

There were no exports of magnesium sulphate in 1923. Imports of magnesium sulphate (Epsom salts) in 1918 to 1923 are shown in the following table:

Magnesium sulphate (Epsom salts) imported for consumption in the United States, 1918–1923

Year	Pounds	Value	Year	Pounds	Value
1918	2, 045	$196	1921	12, 519, 778	$88, 153
1919	17, 647	1, 473	1922	25, 390, 734	200, 203
1920	1, 803, 769	66, 944	1923	14, 455, 920	71, 566

MANUFACTURED MAGNESIUM SALTS

Statistics of manufactured magnesium salts are collected biennially by the Bureau of the Census and represent parts of the crude materials considered on the foregoing pages. The latest available statistics were quoted in the magnesium report for 1922. The data on imports are as follows:

Magnesium compounds imported for consumption in the United States, 1919–1923

Year	Calcined magnesia purified		Carbonate precipitated	
	Pounds	Value	Pounds	Value
1919	22, 637	$11, 358	5, 094	$1, 101
1920	26, 859	9, 093	14, 930	1, 512
1921	35, 182	7, 593	18, 514	2, 061
1922	96, 792	15, 969	36, 254	3, 385
1923	141, 375	30, 802	1, 046, 990	55, 137

METALLIC MAGNESIUM

PRODUCTION AND PRICES

As usual, the American Magnesium Corporation, of Niagara Falls, N. Y., was the only company that reported production and sales of metallic magnesium to the Geological Survey; but one other producer was active. An estimate of the quantity and value of the sales in 1923 is included in the following table:

Domestic metallic magnesium sold or used in the United States, 1918–1923

Year	Pounds	Value		
		Total	Average	
			Ingot (stick)	Powder
1918	284, 118	$615, 217	$1. 81	$2. 67
1919	127, 465	247, 302	1. 83	2. 85
1920	(a)	(a)	1. 60	2. 75
1921	48, 000	86, 000	1. 30	2. 36
1922	[b]60, 000	[b]89, 000	1. 60	1. 13
1923	[b]125, 000	[b]155, 000	1. 25	1. 00

[a] Survey not at liberty to show figures.

[b] Estimate.

The new magnesium produced was made mostly from California magnesite, and the remainder presumably from magnesium chloride.

The total sales of domestic magnesium more than doubled in 1923 but were less than half as great as in 1918, when consumption for war purposes was at its height and imports were comparatively insignificant. In addition to domestic magnesium a considerable quantity of foreign magnesium imported before the tariff became effective was sold, and it would not be surprising if the total sales of domestic and foreign magnesium in 1923 aggregated 175,000 pounds in the form of ingots and manufactured forms.

Sales of ingot metal amounted to about 80,000 pounds, at an average price of $1.25 a pound. Very little foreign ingot metal was sold, and its price probably averaged a little lower than that of the domestic ingots.

Sales of magnesium powder, mostly of foreign origin, may have amounted to as much as 40,000 pounds, mainly for flash-light powders and flare shells. It is estimated that the manufacture of flash-light powder consumes about 25,000 pounds annually. No domestic magnesium powder was produced in 1923, and less than 4,000 pounds was sold, at an average price of about $1 a pound, in competition with foreign magnesium powder.

Sales of castings, rods, sheets, tubing, and wire increased materially. These sales were made largely in connection with experimental work, and the prospects favor larger sales in 1924.

IMPORTS

Imports of magnesium, which had been rushed into the country in 1922 to anticipate the imposition of the new tariff, declined in 1923 nearly to the level of 1919.

Magnesium imported for consumption in the United States, 1919–1923

Year	Pounds	Value	
		Total	Average
1919	13,239	$13,583	$1.02
1920	29,275	25,055	.85
1921	39,913	30,592	.77
1922	182,939	54,448	.30
1923	13,974	11,576	.83

Magnesium imported for consumption in the United States in 1923

	Pounds	Value
Magnesium metallic and scrap	11,381	$7,598
Alloys (magnesium content)	510	572
Powder (magnesium content)	1,496	1,983
Sheets, tubing, ribbons, wire, and all other articles of magnesium	587	1,423
	13,974	11,576

Approximately 12,000 pounds of pure metal arrived too late in 1922 to escape duty and was placed in the warehouse. Parts of this quantity were sold late in 1922 and during 1923, but some remained in the warehouse. About two-thirds of the "imports for consumption" of metallic and scrap magnesium shown above consist of this material, and one-third of magnesium imported in 1923. The average value of the total quantity was 67 cents a pound, but according to one importer the price of imported ingot metal over 99 per cent pure ranged from 70 to 80 cents a pound plus a duty of 40 cents a pound.

Owing to the unsettled conditions in Germany, the chief or only foreign source of metallic magnesium, together with the duty on magnesium, there was little inducement to import magnesium except on definite orders. Speculative buying was too risky, and in this respect the tariff tended to stabilize the industry.

It is interesting to note that in spite of the tariff and the marked decline in imports, the average value of domestic ingot magnesium declined from $1.60 a pound in 1922 to $1.25 in 1923; and indications early in 1924 lead to the inference that the average value for this year will be near $1 a pound. The selling price is governed to a large degree by competition with foreign magnesium, but the reduction in price is made possible by improvement in technique of manufacturing, the installation of equipment for the production of semifinished structural forms in both pure metal and alloys, and progress in uses. The high first cost of magnesium, however, continues to be the principal difficulty in extending its use. As sales increase for uses where price is not a prime factor, further decreases in price may be expected and should promote other uses which thus far have not been commercially practicable.

DEVELOPMENT AND OUTLOOK [14]

The largest use for magnesium continues to be the deoxidizing or desulphurizing of other metals, particularly nickel and Monel metal. This field of use is gradually broadening as the cost of magnesium decreases. Magnesium has also been used experimentally in the deoxidation and desulphurizing of copper, and a considerable quantity is used for scavenging low-grade scrap brass. It is also possible that small quantities of magnesium may improve the qualities of zinc in commercial form.

Magnesium is an essential constituent of high-strength aluminum alloys, the demand for which is rapidly increasing. The magnesium content of these alloys is usually about 0.5 per cent. Other alloys known as magnalium or magnalite consist of an aluminum base with 3 to 6 per cent of magnesium. The use of these alloys also promises to increase.

Although the domestic magnesium powder sold in 1923 came wholly from stocks previously accumulated, the consumption of foreign powder was considerable, and the demand for the powder is expected to improve gradually. As rapid ignition in flash powders is largely dependent on the relation of the bulk of magnesium powder to its weight, the recent placing on the market of a magnesium powder with 40 per cent more volume for a given weight than had been previously obtainable will tend to stimulate the use of flash powders and will better meet the needs of manufacturers of flare shells and tracer bullets.

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[14] Information relating to this subject and on the physical and chemical properties of magnesium and its alloys is contained in a book entitled "Magnesium," published by the American Magnesium Corporation. Niagara Falls, N. Y., in 1923 (177 pages, illustrated by half tones and text figures; price $2.50).

Castings ranging from simple uncored pieces to complicated cored aircraft-motor parts can now be produced. The low specific gravity of magnesium and its property of burning at its melting point have been severe obstacles in the development of the process of casting, far greater than have been met in the casting of any other metal.

Finished products, which have been sold largely on an experimental basis, include aircraft-motor parts, including crank cases, oil pans, fuel-line fittings, pistons, special alloy bearings, and instrument cases; lens holders; field glasses; parts of moving-picture machines; surveying instruments; receivers and transmitters for radio sets; artificial limbs; motorcycle-engine parts; shuttles, bobbins, and spools for weaving machinery; rotating parts of air compressors and vacuum pumps; gasoline line and carbureter fittings; railway signal instrument parts; and balloon valve frames.

Magnesium sheet has been produced suitable for experimental development of the following uses: Moving parts of precision instruments, celluloid-covered drafting rulers, meter disks, scale pointers, chemical-balance parts, hydrofluoric-acid containers, dry-battery elements, speedometer parts, metal buttons, and portable drafting tables. The principal requirement in the production of satisfactory sheet metal is an ingot free from flaws, which in turn involves special melting and alloying equipment and careful regulation of temperature.

The manufacture of extruded rod and tubing has proved simpler than that of other forms, as magnesium and several of its alloys flow readily at pressures and temperatures well within the limits of the extrusion equipment. In addition to this equipment special straightening machines are necessary for the production of marketable material. The products of single extrusions range from a series of eight wires each 0.03 inch in diameter to symmetrical sections of tubing with a maximum diameter of 1⅛ inches. Products now being developed include control levers for aircraft, meter-disk spindles, knitting and crochet needles, tubular tennis-racket frames, fuel lines for aircraft, and tapered tubing for billiard cues.

Magnesium wire has been used principally in the development of vacuum bulbs for radio work. The wire is raised to its melting point inside the bulb and eliminates the last traces of oxygen and nitrogen by chemically combining with them.

One of the most promising developments is that of forging or hot pressing magnesium, as the metal becomes plastic and flows readily at temperatures well within the limits of commercial practice. After it has been sufficiently worked to destroy the cast grain texture, it assumes qualities that commend its consideration for pistons and connecting rods for internal-combustion engines, propellers and supercharger disks for aircraft, golf-club heads, and parts of machines where this process of form changing may supersede casting.

STRONTIUM

By George W. Stose[1]

STRONTIUM ORE

PRODUCTION

Strontium ore was mined in the United States in 1916, 1917, and 1918, but none has been mined since. The total quantity mined in the United States is less than 5,000 short tons. Most of this was obtained from deposits in California, but some was mined in Arizona, Texas, and Washington. Other workable deposits have been reported in Utah. All these deposits have been briefly described in the reports on strontium for 1916, 1918, and 1919. Most of the ore is celestite (strontium sulphate), but some in California and Washington is strontianite (strontium carbonate). Interference with commerce during the World War created a market for domestic ores that resulted in temporary activity in the mining of strontium ore in this country, but this activity ceased as soon as foreign trade was reestablished. The deposits, however, are still available should the demand again arise or the price increase sufficiently to enable the producers to put the ore on the market in competition with imported ore. The market at present is chiefly at or near the Atlantic seaboard.

IMPORTS

The quantity of crude strontium ore imported prior to 1923 can not be determined, because a separate report of it was not kept in the customs offices at ports of entry prior to September 22, 1922, when the new tariff went into effect. It is estimated that between 1,500 and 2,000 short tons of ore is imported annually. In 1923 nearly 1,680 short tons of strontium ore was imported, valued at more than $12,500 at foreign ports of shipment.

Strontianite and celestite imported into the United States in 1922 (last quarter only) and 1923

Year	Pounds	Value
1922 (Sept. 22 to Dec. 31)	1,000	[a] $40
1923	3,357,891	12,564

[a] The high value of the material imported in 1922 ($80 a ton) implies that this ore was ground and not crude lump ore.

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[1] Statistical data prepared chiefly by Mrs. E. R. Phillips. Statistics of imports compiled by J. A. Dorsey from the records of the Bureau of Foreign and Domestic Commerce.

PRICES

The price obtainable for strontium ore that might be mined in the United States is controlled by the price of the imported product delivered at the Atlantic ports of entry, because the factories that use most of the ore are in the eastern part of the country. Domestic celestite sold in 1917, during the war, at about $22 a ton and strontianite at about $38, but the deposits could probably be worked at a profit at much lower prices. The price of imported strontium ore at foreign ports of shipment in 1923 was about $7.50 a ton. To this should be added the ocean transportation and delivery charges, making the estimated cost at the American seaboard about $9.50 a ton. There is no duty on strontium ore. Mining of domestic strontium-ore deposits appears to be dependent on the development of a western market for strontium chemicals, such as would result from the use of strontium salts in the manufacture of beet sugar by a process in general use in certain parts of Europe.

KNOWN STRONTIUM DEPOSITS IN THE UNITED STATES

Manufacturing companies that use strontium ore may be interested to learn of domestic deposits which have been either mined or prospected and some of which are available for development. The following is a list of such deposits:

Deposits of strontium ore in the United States

Owner	Location	
	Nearest town	County
Arizona:		
Lambert Frye, Gila Bend, Ariz	Gila Bend	Maricopa.
Arkansas:		
Dr. A. Wade Schiertalla, Murfreesboro, Ark	Murfreesboro	Pike.
California:		
Avawatz Salt & Gypsum Co., 1112 Garland Building, Los Angeles, Calif.	Silver Lake	San Bernardino.
T. J. Neilan, 316 Bush Street, San Francisco, Calif	Barstow	Do.
David B. Roberts, 2554 East Colorado Street, Pasadena, Calif.	Westmoreland	Imperial.
W. H. Schlosser, 569 Nelson Way, San Jose, Calif		
H. S. Anderson, Stagg, Calif	Lavic	San Bernardino.
Texas:		
R. C. Walker, Austin, Tex	Austin	Travis.
Utah:		
T. D. Richards, Cleveland, Utah	Emery	Emery.
Oscar Beebe, Green River, Utah	do	Do.
Washington:		
D. C. Bard, 660 Stuart Building, Seattle, Wash	La Conner	Skagit.

STRONTIUM CHEMICALS

PRODUCTION

Strontium chemicals were manufactured in the United States in 1923 chiefly from celestite imported from England. Three plants made strontium chemicals from ore during the year. E. I. du Pont de Nemours & Co. produced the largest quantity of chemicals at their plant at Paulsboro, N. J. The other producers in 1923 were the Mallinckrodt Chemical Works, at St. Louis, Mo., and the Powers-Weightman-Rosengarten Co., at Philadelphia, Pa. Strontium nitrate, bromide, carbonate, and chloride were produced and are named in the order of quantity sold. Small quantities of other strontium chemicals, chiefly medicinal, were also produced. The total quantity of strontium chemicals sold by these three plants in 1923 was more than 635,000 pounds greater than in 1922 and about three times the quantity sold in 1921.

Strontium chemicals (manufactured in the United States from domestic and imported crude ore) sold in 1918–1923

Year	Pounds	Value	Year	Pounds	Value
1918	4, 148, 270	$622, 546	1921	847, 368	$118, 655
1919	2, 191, 409	402, 057	1922	2, 040, 550	204, 022
1920	4, 713, 015	864, 251	1923	2, 676, 260	303, 719

IMPORTS

Strontium nitrate was the chief strontium chemical imported in 1923. During the year 1,886,861 pounds, valued at $116,255, was imported. This material was used chiefly in the manufacture of signals and fireworks. The amount of precipitated strontium carbonate imported in 1923 was 37,066 pounds, valued at $2,601. Figures for previous years, prior to September 22, 1922 when the Fordney tariff act became operative, are not available for comparison.

Strontium chemicals imported into the United States September 22 to December 31, 1922, and in 1923

	1922 (Sept. 22–Dec. 31)		1923	
	Pounds	Value	Pounds	Value
Strontium carbonate, precipitated	5, 578	$972	37, 066	$2, 601
Strontium nitrate	360, 781	20, 831	1, 886, 861	116, 255
Strontium oxide	10, 002	582		

USES AND MARKET

Strontium compounds are used chiefly in the manufacture of signal lights and fireworks. Much smaller quantities of chemically pure compounds are used in medicines and the arts. Celestite (strontium sulphate) is the most common strontium mineral and is the chief ore imported for use in the manufacturing plants. Strontium carbonate is a stable compound that can be readily handled, stored, and shipped, and considerable ore is converted into carbonate by treatment with soda ash (sodium carbonate) before it is exported to this country. Strontium carbonate is used in the manufacture of other strontium compounds, and considerable quantities of strontianite (mineral carbonate of strontium), as well as chemically precipitated carbonate, are imported for this purpose. Strontium nitrate can be made from the carbonate by treatment with nitric acid, but much of the strontium nitrate used in this country is made by converting ore (strontium sulphate) into sulphide by roasting with powdered coal and then treating the sulphide with nitric acid. Strontium nitrate is not so stable as the carbonate and not so suitable to transport for long distances, but by using proper containers it is imported in large quantities. It is also the chief strontium compound made in domestic plants. The nitrate is used in the manufacture of pyrotechnic red fire and lights, railroad flares, signals, and fusees, signal shells, and signal lights. Strontium bromide, salicylate, chloride, hydroxide, and other compounds are made for medicinal use and chemical reagents. Strontium chemicals are now made chiefly in the Atlantic States, although considerable quantities are made in St. Louis, Mo. During the World War some were made in California and Washington.

The following companies are dealers in strontium chemicals:

C. W. Campbell Co., 11 Cliff Street, New York, N. Y.
Charles Cooper & Co., 194 Worth Street, New York, N. Y.
H. P. Diehl, Lawrenceburg, Ind.
Dow Chemical Co., Midland, Mich.
E. I. du Pont de Nemours & Co., Wilmington, Del.
Foote Mineral Co., 111 North Nineteenth Street, Philadelphia, Pa.
Heyden Chemical Works, 80 Fifth Avenue, New York, N. Y.
Hummel & Robinson Corporation, 90 West Street, New York, N. Y.
Innis, Speiden & Co., 46 Cliff Street, New York, N. Y.
A. Klipstein & Co., 644 Greenwich Street, New York, N. Y.
Lehn & Finck (Inc.), 635 Greenwich Street, New York, N. Y.
Mallinckrodt Chemical Works, 3600 North Second Street, St. Louis, Mo.
Merck & Co., 45 Park Place, New York, N. Y.
Meteor Products Co. (Inc.), 53 Park Place, New York, N. Y.
Pfalz & Bauer, 300 Pearl Street, New York, N. Y.
Charles Pfizer & Co. (Inc.), 81 Maiden Lane, New York, N. Y.
Powers-Weightman-Rosengarten Co., Box 1625, Philadelphia, Pa.
Roessler & Hasslacher Chemical Co., 100 William Street, New York, N.Y.
Strong, Cobb & Co., Cleveland, Ohio.

FLUORSPAR AND CRYOLITE

By Hubert W. Davis

FLUORSPAR

Fluorspar, or fluorite, is a nonmetallic mineral that usually occurs in glassy transparent cubes or cleavable masses. Less commonly it is granular or fibrous in structure, and occasionally banded fluorspar is found. It has a specific gravity of 3.2, is brittle, has a hardness of 4, and can easily be scratched by a knife. Chemically it consists of calcium and fluorine in the proportion of 51.1 to 48.9. In color fluorspar ranges, according to purity, from a clear colorless or slightly bluish glasslike substance through various brilliant hues, of which purple and green are most common, and much of it is white and opaque.

FLUORSPAR MINED AND SHIPPED

The shipments of fluorspar from domestic mines in 1923 decreased 14 per cent in quantity and 1 per cent in value as compared with those in 1922. Colorado and New Mexico were the only States that showed an increase in 1923. The shipments of fluorspar to foundries and for use in the manufacture of hydrofluoric acid, glass, enamel, and sanitary ware were larger than in 1922, and the shipments to steel plants and for export were smaller. The general average price per ton f. o. b. mines or shipping points for all grades in 1923 was $20.68, an increase of $2.80 from the average in 1922. The highest average price in 1923 was reported from New Hampshire, and the lowest from Colorado.

The exact quantity of crude fluorspar mined can not be ascertained, because at most of the smaller mines only the cleaned material is weighed. The total quantity of merchantable fluorspar recovered by mining and milling in 1923 showed an increase of 12 per cent over 1922.

Merchantable fluorspar recovered in the United States in 1922 and 1923, by States

State	1922		1923		
	Short tons	Percentage	Short tons	Percentage	Number of producers
Illinois	82,309	61.77	93,845	62.93	12
Kentucky	46,216	34.68	44,483	29.83	26
Colorado	2,044	1.53	6,252	4.19	6
Nevada	280	.21			
New Mexico	1,760	1.32	4,438	2.98	6
New Hampshire	650	.49	97	.07	1
Utah					
	133,259	100.00	149,115	100.00	51

Fluorspar produced [a] *in the United States, 1880–1923*

Year	Illinois		Kentucky		Other States		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1880–1901	(b)	(b)	(b)	(b)	(b)	(b)	178, 117	$1, 067, 655
1902–1917	986, 334	$6, 404, 498	c 310, 498	c $2, 336, 737	c 62, 575	c $482, 553	1, 359, 407	9, 223, 788
1918	132, 798	2, 887, 099	87, 604	2, 069, 185	43, 415	509, 197	263, 817	5, 465, 481
1919	92, 729	2, 430, 361	32, 386	883, 171	13, 175	212, 042	138, 290	3, 525, 574
1920	120, 299	3, 096, 767	46, 091	1, 246, 942	20, 388	374, 838	186, 778	4, 718, 547
1921	12, 477	315, 767	15, 266	294, 513	7, 217	113, 814	34, 960	724, 094
1922	83, 855	1, 493, 188	52, 484	970, 059	5, 257	67, 918	141, 596	2, 531, 165
1923	65, 045	1, 443, 490	45, 441	945, 402	10, 702	116, 927	121, 188	2, 505, 819
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[a] Beginning with 1906 figures represent shipments from mines.
[b] Figures by States not available.
[c] Small quantity from Colorado and Tennessee included with Kentucky.

Such details of the shipments of fluorspar from 1920 to 1923, by States, as may be published without revealing statistics of individual producers, except by permission, are given in the following table:

Fluorspar shipped from mines in the United States, 1920–1923

State	Gravel			Lump			Ground			Total		
	Short tons	Value		Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
1920												
Illinois	103,486	$2,396,322	$23.16	8,332	$381,171	$36.27	8,481	$537,151	$43.32	120,299	$3,096,767	$25.74
Kentucky	39,997	1,029,195	25.73	2,178			3,916			46,091	1,246,942	27.05
Nevada	530	[a] 13,332	17.61	----	[a] 8,608	20.30	2			532	22,070	18.66
New Hampshire	[a] 202			(a)			----	----	----	202		
Utah	----			268			----	----	----	268		
Arizona	25			156			----	----	----	181		
Colorado	10,076	157,768	14.96	2,776	195,000	22.52	----	----	----	12,852	251,308	19.55
New Mexico	470			5,883			----	----	----	6,353	101,460	15.97
	[a] 154,786	[a] 3,596,617	23.24	[a] 19,593	[a] 584,779	29.85	12,399	537,151	43.32	186,778	4,718,547	25.26
1921												
Colorado	3,143	39,907	12.70	----	----	----	----	----	----	3,143	39,907	12.70
Illinois	8,208	146,746	17.88	1,099	80,838	21.39	3,170	235,981	40.00	12,477	315,767	25.31
Kentucky	11,714	185,451	15.83	1,689			1,863			15,266	294,513	19.29
New Mexico	1,650	21,450	13.00	991			866			3,507	60,186	17.16
New Hampshire	[a] 567	[a] 13,721	24.20	(a)	(a)	----	----	----	----	567	13,721	24.20
	[a] 25,282	[a] 407,275	16.11	[a] 3,779	[a] 80,838	21.39	5,899	235,981	40.00	34,960	724,094	20.71
1922												
Colorado	2,309	20,169	8.73	----	----	----	----	----	----	2,309	20,169	8.73
Illinois	76,537	1,243,151	16.24	1,722	96,033	18.57	5,596	368,649	36.42	83,855	1,493,188	17.81
Kentucky	45,680	774,086	16.95	2,629			4,175			52,484	970,059	18.48
New Mexico	1,008	12,320	12.22	820			352			2,180	30,992	14.22
Other States [b]	[a] 690	[a] 15,353	22.25	[a] 78	[a] 1,404	18.00	----	----	----	768	16,757	21.82
	[a] 126,224	[a] 2,065,079	16.36	[a] 5,249	[a] 97,437	18.56	10,123	368,649	36.42	141,596	2,531,165	17.88
1923												
Colorado	3,957	36,631	9.26	2,087	23,079	11.06	----	----	----	6,044	59,710	9.88
Illinois	52,249	1,013,927	19.41	5,659	232,846	26.37	7,137	398,118	36.86	65,045	1,443,490	22.19
Kentucky	39,394	756,701	19.21	2,432			3,615			45,441	945,402	20.81
New Mexico	3,540	38,161	10.78	738			50			4,328	50,861	11.75
New Hampshire	----	----	----	142	6,356	19.26	----	----	----	142	6,356	19.26
Utah	----	----	----	188			----	----	----	188		
	99,140	1,845,420	18.61	11,246	262,281	23.32	10,802	398,118	36.86	121,188	2,505,819	20.68

[a] Some lump fluorspar included with gravel.

[b] New Hampshire and Utah.

FLUORSPAR INDUSTRY, BY STATES

Colorado.—The fluorspar shipped from mines in Colorado in 1923 increased 162 per cent. The mineral was obtained from Wagon Wheel Gap, Mineral County; in the Jamestown district, Boulder County; near Cowdrey, Jackson County; and at a newly opened deposit near Cotopaxi, Custer County. The greater part of the fluorspar produced in Colorado was used at the steel works at Pueblo. It is reported that the fluorspar properties at Wagon Wheel Gap have been purchased by the Colorado Fuel & Iron Co. to insure an ample supply of fluorspar for its steel works at Pueblo. At the deposit near Cowdrey, from which the initial shipment was made in 1922, development work underground was continued. A new steam plant was installed, and two houses with accommodations for 50 men were built. A milling plant consisting of grizzlies, dry trommel, washer, picking belt, and crusher was completed and put into operation.

Illinois.—The productive deposits of fluorspar in Illinois are in Hardin and Pope counties, in the extreme southern portion of the State. The principal mines are near Rosiclare, Elizabethtown, and Cave in Rock, small towns on Ohio River, in Hardin County. The largest deposit yet discovered, known as the Rosiclare-Fairview vein, situated in Hardin County, occurs in a fault fissure. The country rock is limestone and sandstone. The fluorspar occurs in lenticular masses in the vein, which pinches laterally and vertically. At Cave in Rock fluorspar occurs in flat-lying tabular masses, locally called "blanket" formations. A detailed report on the southern Illinois district has been published by the Illinois Geological Survey.[1] This report describes the principal mines and prospects, discusses the mining and milling methods employed, and offers suggestions for prospecting. It is illustrated by topographic and geologic maps, which show the location of the fluorspar mines.

There was a slack demand for Illinois fluorspar in 1923, and as a result the shipments showed a decrease of 22 per cent from 1922. Except for those in 1921, the shipments were the lowest since 1910. There was an increase in production, however, and the stocks at the mines were much larger at the end of the year.

The Hillside Fluor Spar Mines has leased the property formerly operated by the Indiana Fluor Spar & Lead Co., consisting of 40 acres near Elizabethtown, Ill. At this property, now known as Hillside No. 2 mine, two shafts have been sunk to depths of 65 and 100 feet on a new vein with ore of good grade. This mine is producing ore at a rate of 25 tons daily, which it is hoped to increase to 100 tons. Development work at Hillside No. 1 mine, on the eastern extension of the Rosiclare vein, was kept well ahead of hoisting requirements, and a large quantity of ore is broken in the stopes.

The output of the Fairview Fluorspar & Lead Co. was obtained from the Argo and Extension mines. At the Argo mine, on the Golconda or Daisy vein, the shaft has been sunk to a depth of 320 feet and the vein crosscut at 50, 220 and 320 feet. The vein is reported to be 17 feet wide in the widest point so far noted, and about half of this width was good fluorspar.

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[1] Weller, Stuart, and others, The geology of Hardin County: Illinois Geol. Survey Bull. 41, 1920.

The Spar Mountain mine, near Cave in Rock, was operated during the first half of 1923 but except for some exploratory work was inactive the remainder of the year.

The output of the Rosiclare and Daisy mines of the Rosiclare Lead & Fluorspar Mining Co. was less throughout the year than in 1922.

The Patrick mine of the Webber-Wood Spar Mining Co., near Rosiclare, at which prospecting and sinking of a shaft have been in progress, made its initial shipment in 1923.

A small quantity of high-grade fluorspar was shipped from the newly opened Douglas mine, in Pope County.

Kentucky.—The fluorspar deposits thus far developed in western Kentucky are in Crittenden, Livingston, and Caldwell counties, but the mines of Crittenden County include not only the largest producers but the largest number of productive veins. Commercial deposits of fluorspar also occur in central Kentucky, and during recent years a small and irregular production has been reported from Mercer and Woodford counties. A study of the fluorspar deposits of the western and central Kentucky districts has been made by Currier.[2]

The fluorspar shipped from Kentucky in 1923, all of it from the western district, the mines in the central district being inactive, showed a decrease of 13 per cent.

A feature of the year was the entry of the Lafayette Fluorspar Co., a subsidiary of the United States Steel Corporation, as a producer in the western Kentucky district. The fluorspar-bearing properties acquired by this company extend for about 3 miles in a southwesterly direction from Mexico, a station on the Illinois Central Railroad, and include the Mathews, Asbridge, Tabor, Tabb, Wheatcroft, Yandell, and Pogue mines. Owing generally to lack of capital, fluorspar mining in this district has been done in a crude manner, but the advent of the Steel Corporation will undoubtedly lead to the building of a modern mill, sinking of suitable shafts, improvement in transportation facilities, building of surface plants, and employment of the most approved mining practice.

A small output was reported by the Ohio-Kentucky Fluorspar & Lead Corporation from its Klondyke mine, near Smithland, at which development work has been in progress and the building of a mill is reported to be nearing completion.

Development work was done at a property about 7 miles southwest of Marion by W. P. Michell, who reports a shaft sunk to a depth of 75 feet, from which, at the 70-foot level, a crosscut of 20 feet was made to the vein.

The Roberts Fluorspar Co., which operates a mill at Marion for the preparation of fluorspar, has added a grinding plant consisting of a dryer, conveyors, and elevators and having a daily capacity of 30 tons of 200-mesh fluorspar.

A small quantity of fluorspar was produced in the course of development work from a newly opened deposit near Princeton, Caldwell County.

New Hampshire.—A small output was reported from the Stoddard and Pierce mines, near Westmoreland, Cheshire County. During the last few years these mines and the Wheeler and Springer mines have been leased to the American Steel & Wire Co., but all leases were surrendered December 1, 1923.

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[2] Currier, L. W., Fluorspar deposits of Kentucky: Kentucky Geol. Survey, 6th ser., vol. 13, 1923.

New Mexico.—An increase of 99 per cent in the shipments of fluorspar from New Mexico was recorded in 1923. The greater part of the output was shipped to the steel works at Pueblo, Colo., and some went to steel plants in the East. The Tortugas mine, near Mesilla Park, in Dona Ana County; a newly opened deposit 6 miles north of Cliff, in Grant County; and the Nakaye mine, in Sierra County, supplied practically all the fluorspar produced in New Mexico in 1923. Development work was reported and some fluorspar mined from a deposit near Hot Springs, Sierra County.

Utah.—No fluorspar was mined in 1923 at the Silver Queen mine, near Clive, Tooele County, Utah, but some shipments to Pacific coast steel plants were made from the stock pile at the mine.

STOCKS OF FLUORSPAR

According to the reports of producers the total quantity of fluor spar in stock at the mines or at shipping points at the end of 1923 amounted to 64,365 short tons, an increase of 93 per cent over the stock at the end of 1922. As the quantity of fluorspar in stock piles is of necessity partly estimated, there are variations in the mine reports from year to year that prevent an absolute balance between the quantity mined and the quantity shipped and in stock. The stocks at the end of 1923 are the largest ever accumulated by producers and will probably result in considerable curtailment in output during 1924. Data on consumers' stocks are noted under "Consumption and uses" (pp. 34–36).

Stocks of fluorspar at mines or shipping points in the United States in 1922 and 1923, by States, in short tons

State	1922	1923
Arizona	400	400
Colorado	1,880	1,480
Illinois	22,691	55,326
Kentucky	7,471	6,387
Nevada	530	530
New Hampshire	45	
New Mexico	50	160
Utah	270	82
	33,337	64,365

IMPORTS AND EXPORTS[3]

The imports of fluorspar into the United States in 1923 amounted to 42,226 short tons and were the largest since 1910, when 42,488 tons was imported. They showed an increase of nearly 28 per cent in quantity and 44 per cent in value over the imports in 1922. The value at the foreign mines averaged $10.24 a ton.

The imports were equivalent to about 35 per cent of the domestic shipments of fluorspar, as compared with about 23 per cent in 1922.

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[3] The statistics of imports were compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce; those of exports were furnished by the producers. No exports of fluorspar are recorded by the Bureau of Foreign and Domestic Commerce.

England continues to be the principal source of the imported fluorspar, supplying 54 per cent of the total in 1923. The value declared for English fluorspar at the mines is $8.86 a short ton. The cost to the consumers in the United States includes in addition the duty of $5 a ton, the ocean freight charges, reliably reported to be about $3 a ton, the cost of transporting the fluorspar from the mines to the docks, loading charges at the docks, and other small charges. The imports of German fluorspar again increased in 1923 and probably would have been larger had not considerable difficulty been encountered in obtaining the mineral. It is reported that some sales of German fluorspar were made at $20 a ton, duty paid, delivered at tidewater, for washed gravel containing 85 per cent of calcium fluoride and 5 per cent of silica.

Nearly one-fourth of the imports in 1923 (10,380 tons) came from British South Africa. Practically all the fluorspar from this source was of "acid" grade and was used in the manufacture of hydrofluoric acid at East St. Louis, Ill., Philadelphia, Pa., New York, N. Y., and Grasselli, Ind. The ocean freight from Cape Town, the port of shipment, is said to average about 25 shillings a ton. Some notes on one of the South African deposits are given on page 37.

Imports from Italy, China, and Netherlands are recorded for the first time. The quantities were small, but the imports from Italy will probably increase, as the price at which this material was sold indicates low cost of production and low ocean freight rates. Notes on the Italian deposit are given on pages 37–38.

Canada, which in recent years has been shipping considerable fluorspar to the United States, was not a competitor in 1923, as the Rock Candy mine, in British Columbia, whence most of the mineral came, was inactive during practically the entire year.

By the tariff act of 1922 the import duty on fluorspar was increased from $1.50 a long ton ($1.34 a short ton) to $5.60 a long ton ($5 a short ton).

The distances that domestic fluorspar must be transported by rail from mines to steel plants in the Lehigh and Susquehanna valleys of Pennsylvania are generally much greater than the distances that foreign fluorspar must be moved from the ports of entry to these plants; moreover, a large part of the imported material is carried as ballast, making possible a lower market price than would have to be charged if it were carried as a primary cargo. Except when ocean freight rates are moderate, however, foreign fluorspar is not in a position to enjoy much advantage in American markets, for the reason that it is not generally of so high grade as the mechanically treated domestic product, and as fluorspar is of value chiefly according to its purity, purchasers should find that the purer American fluorspar is more efficient and consequently cheaper in the end.

The producers of fluorspar reported exports in 1923 amounting to 1,144 short tons, valued at $25,312, or $22.13 a ton, as compared with 2,296 tons, valued at $40,966, or $17.84 a ton, in 1922. All the exported fluorspar went to Canada.

Fluorspar imported into the United States in 1922 and 1923, by countries

[General imports]

Country	1922			1923		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Belgium	71	$1,187	$16.72	35	$712	$20.34
British South Africa	486	8,415	17.31	10,380	157,625	15.19
Canada	2,877	32,679	11.36	(a)	5	
China				90	1,183	13.14
Czechoslovakia	34	761	22.38			
England	23,836	206,950	8.68	22,862	202,548	8.86
Germany	5,804	49,196	8.48	8,580	67,595	7.88
Italy				268	2,471	9.22
Netherlands				11	180	16.36
	33,108	299,188	9.04	42,226	432,319	10.24

[a] Quantity not recorded.

Fluorspar imported into the United States in 1922 and 1923, by districts of entry

[General imports]

District of entry	1922			1923		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Buffalo	44	$484	$11.00	(a)	$5	
Dakota	2,833	32,195	11.36			
Los Angeles	257	3,043	11.84	44	1,115	$25.34
Maryland	6,531	51,656	7.91	6,055	51,058	8.43
Massachusetts				60	488	8.13
Mobile				7,091	119,401	16.84
New Orleans				2,143	28,485	13.29
New York	3,273	36,668	11.20	4,287	42,612	9.94
Philadelphia	19,366	164,960	8.52	22,034	182,085	8.26
Rochester				(a)	3	
San Francisco	576	6,102	10.59	226	4,404	19.49
Washington	228	4,080	17.89	286	2,663	9.31
	33,108	299,188	9.04	42,226	432,319	10.24

[a] Quantity not recorded.

CONSUMPTION AND USES

The market for the bulk of fluorspar sold in the United States depends on the condition of the steel industry, and the demand fluctuates with the rise and fall in the production of basic open-hearth steel. From 80 to 85 per cent of the fluorspar produced in the United States is used as a flux in the production of steel by the basic open-hearth process. For this purpose steel makers require that the fluorspar be in pieces not larger than three-quarters of an inch and show on analysis at least 80 per cent of calcium fluoride and not more than 6 per cent of silica. This flux is used principally for giving fluidity to slags that are otherwise too viscous, but at the same time it facilitates the passage of impurities such as sulphur and phosphorus into the slag.

Fluorspar is also used extensively in the manufacture of ceramic products, such as enameled and sanitary ware, opalescent glass, facing for bricks, and vitriolite, and in the manufacture of hydrofluoric acid. For ceramic products and glass manufacture a ground fluorspar analyzing 92 to 98 per cent of calcium fluoride and from 1 to 4 per cent of silica is demanded. For the manufacture of hydrofluoric acid the fluorspar is sold either in lump form or pulverized and is usually guaranteed to contain not less than 98 per cent of calcium fluoride and not over 1 per cent of silica. In the manufacture of hydrofluoric acid the fluorspar is treated with sulphuric acid, and in the process the presence of impurities in the fluorspar, such as calcium carbonate and silica, is very detrimental. The calcium carbonate neutralizes sulphuric acid, and its presence to the extent of 1 per cent or more causes considerable foaming upon mixing. Silica, if present, forms hydrofluosilicic acid in such proportion that for every part of silica nearly four parts of fluorspar and more than five parts of sulphuric acid of 66° B. are wasted, because for practically all applications of hydrofluoric acid the content of hydrofluosilicic acid is useless. Thus for 1 per cent of silica, 10 per cent should be deducted from the value of the fluorspar,[4] and so on.

Fluorspar also finds use as a flux in some blast-furnace operations and in iron and brass furnaces; in the smelting of gold, silver, and copper ores; in the refining of copper, antimony, and lead; in the bond for the constituents of emery wheels; in carbon electrodes; in the manufacture of sodium fluoride used as a wood preservative; and in connection with the extraction of potash from feldspar and from flue dust of Portland cement works.

Data furnished by steel manufacturers who produced 32,234,761 long tons of basic open-hearth steel ingots in 1923, or 94.5 per cent of the total made by all steel manufacturers, show that they consumed 130,499 short tons of fluorspar during the year and had stocks on hand amounting to 47,219 short tons on January 1, 1924. If the few steel companies from which no reports were received consumed a like proportion of fluorspar, the figures given indicate a total consumption in all steel plants of about 138,000 tons and total stocks of about 49,900 tons. Similar information indicated a consumption of 104,000 tons for all plants in 1922 and stocks of about 65,000 tons on January 1, 1923. The reports show that the consumption of fluorspar per ton of steel produced in 1923 ranged from 4.5 to 24.2 pounds and averaged 8.1 pounds. In 1922 it ranged from 5.3 to 18.5 pounds and averaged 7.4 pounds.

The manufacturers of electric-furnace ferroalloys reported the consumption of 286 tons of fluorspar in 1923 and had stocks of 194 short tons on January 1, 1924.

The aggregate stocks of fluorspar at steel plants on January 1, 1924, were the lowest recorded for several years except 1921, so that if the prosperity generally forecast for the steel industry in 1924 arrives the fluorspar mines will be drawn upon to furnish a larger quantity of fluorspar than in 1923.

The shipments of domestic fluorspar plus the imports minus the exports give from year to year an index to the quantity made available for consumption and indicate its relative increase or decrease. The total quantity of all grades of fluorspar made available for consumption in 1923 was 161,928 short tons, a decrease of 6 per cent compared with 1922. The general relation between the total supply of fluorspar and the output of open-hearth steel may be noted by comparison of the following tables:

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[4] Information according to J. E. Foster, General Chemical Co., published in Illinois Geol. Survey Bull. 41, 1920.

Fluorspar made available for consumption in the United States, 1919–1923, in short tons

Year	Shipments from mines	Imports for consumption	Exports	Available for consumption
1919	138, 290	6, 943	(a)	145, 233
1920	186, 778	24, 612	b 2, 764	208, 626
1921	34, 960	6, 229		41, 189
1922	141, 596	33, 108	b 2, 296	172, 408
1923	121, 188	41, 884	b 1, 144	161, 928

a Not available.
b Reported by producers; none recorded by Bureau of Foreign and Domestic Commerce.

Open-hearth steel produced in the United States in 1919–1923, in long tons

[From reports of the American Iron and Steel Institute]

Year	Basic	Acid	Total
1919	25, 719, 312	1, 229, 382	26, 948, 694
1920	31, 375, 723	1, 296, 172	32, 671, 895
1921	15, 082, 564	507, 238	15, 589, 802
1922	28, 387, 171	921, 812	29, 308, 983
1923	34, 665, 021	1, 234, 636	35, 899, 657

SHIPMENTS, BY USES

The large dependence of the fluorspar industry on the steel industry is clearly shown by the fact that by far the greater part of the fluorspar shipped is taken by steel manufacturers. There is considerable variation in the average value per ton of the fluorspar shipped to the several industries. The high value of fluorspar for hydrofluoric acid and glass and enameled ware is due to the high quality demanded.

Fluorspar shipped from mines in the United States in 1922 and 1923, by uses

Use	1922				1923			
	Percentage	Short tons	Value		Percentage	Short tons	Value	
			Total	Average			Total	Average
Steel	86. 44	122, 403	$1, 987, 586	$16. 24	79. 80	96, 713	$1, 762, 602	$18. 23
Foundry	2. 12	2, 998	57, 011	19. 02	3. 09	3, 748	79, 452	21. 20
Glass and enamel ware	6. 29	8, 904	323, 116	36. 29	8. 89	10, 768	389, 515	36. 17
Hydrofluoric acid (including fluorspar used in manufacture of aluminum)	3. 38	4, 782	118, 648	24. 81	5. 76	6, 976	210, 596	30. 19
Miscellaneous	. 15	213	3, 838	18. 02	1. 52	1, 839	38, 342	20. 85
	98. 38	139, 300	2, 490, 199	17. 88	99. 06	120, 044	2, 480, 507	20. 66
Exported to Canada	1. 62	2, 296	40, 966	17. 84	. 94	1, 144	25, 312	22. 13
	100. 00	141, 596	2, 531, 165	17. 88	100. 00	121, 188	2, 505, 819	20. 68

FLUORSPAR IN FOREIGN COUNTRIES

SOUTH AFRICA[5]

The chief occurrences of fluorspar in South Africa are southeast of Ottoshoop, in the Zeerust district of the Transvaal, where a very large quantity appears to be available. The deposit has the form of a funnel-shaped pipe in disturbed dolomite and chert. The pipe measures 120 by 120 feet at the surface and 80 by 60 feet at a depth of 40 feet. In its peripheral portion the deposit consists of grayish and purple fluorspar, in places containing a little pyrite. The interior is very pure fluorspar, which in parts is good enough for optical work.

At present the fluorspar after being quarried is hauled by oxen up the incline, where the lump fluorspar is cut and loaded into wagons, the smaller material being run through ½-inch sieves to remove the dust.

The cost of production is about 12 shillings a ton f. o. b. railroad cars, made up of 5 shillings for production at the quarry and 7 shillings for sorting and wagon haul for 8 miles over bad roads. The cost of transportation to the Table Bay docks, Cape Town, is 20 shillings a ton. The cost of production will increase with the depth.

The annual consumption of fluorspar in South Africa is about 250 to 350 tons. The principal consumers are the steel mills. During 1922 the owner of the deposit obtained an order for 2,000 tons for the United States and one for 200 tons for Australia, at a price of 55 shillings f. o. b. cars at Table Bay docks for material guaranteed to contain 98 per cent or more of calcium fluoride and less than 1 per cent of silica. The owner states that the price seems too low considering the cost of transportation from the quarry, the care that must be taken to insure the high purity required, and the loss due to sieving. These orders, it is stated, were taken to enable the operator to do some development work.

ITALY

The production of fluorspar in Italy showed rapid development in the years 1915 to 1918, when several thousand tons was produced by the military authorities from what is probably the largest deposit in Italy. The mine has been developed by five levels over a total length of 1,000 meters (3,281 feet) and a height of about 200 meters (656 feet). Along its surface exposure it shows an average width of 0.5 meter (1.6 feet); at the adit level this average increases to 1 meter (3.3 feet), and at the shaft level, 30 meters (98 feet) below, to 1.5 meters (4.9 feet). The highest-grade fluorspar is sorted from a picking belt in the mill, which should yield 20 to 30 tons a day of lump containing 95 per cent of calcium fluoride and less than 3 per cent of silica. A product containing 98 per cent of calcium fluoride is also obtained by hand sorting. To permit the transportation of 50 tons or more of fluorspar a day and to reduce the present cost a ropeway from the mine to Sarentino, a distance of 14 kilometers (8.7 miles), has been begun. The first section of 3½ kilometers (2.2 miles) was about half completed in the autumn of 1923, and it is planned to finish the ropeway in 1924. From Sarentino the product is transported by autotrucks or teams to the railway station at Bolzano. The nearest port to Bolzano is Venice, and the cost of railroad transportation to Venice and loading charges at that port is said to be about $3.45 a ton. A flat rate, however, from Bolzano to New York and other Atlantic ports by way of Genoa has been obtained.

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[5] Donald, G. K., American consul, Johannesburg, South Africa, letter dated Jan. 31, 1923.

NORWAY [6]

The production of fluorspar in Norway was small until 1915, when as a result of the war the country was obliged to utilize its own resources. The output from 1915 to 1919 amounted to 1,035 metric tons, but since 1919 there has been no organized effort at production, for the reason that mining is expensive and German fluorspar can be marketed in Norway at a price with which Norwegian operators can not profitably compete. The consumption of fluorspar in Norway is only about 500 tons annually.

The two chief deposits of fluorspar in Norway are near Kongsberg, Buskerud County, and near Dalen, Telemarken County. The deposits are some distance from the coast, making a railway haul necessary. At present freight rates are high. The fluorspar content of the Kongsberg deposit is stated to be 65 per cent. At Dalen the veins are from 3 to 3.5 meters (9.8 to 11.4 feet) wide, and the fluorspar content is from 75 to 80 per cent.

SWITZERLAND [7]

No fluorspar has been mined in Switzerland during the last five years. In 1888–89 a group of German concerns exploited a fluorspar deposit at Oltschikopf, south of Brienzwyler, in the Canton of Berne. At this place a clear, colorless fluorspar was found that could be used in combination with borate and phosphate glass for making lenses for microscopes. The deposit was soon exhausted.

In June, 1922, the mineralogist of the University of Basel investigated a deposit of fluorspar discovered on the side of Mont Chemin between Martigny and Sembrancher, in the Canton of Valais, and found it of sufficient value to warrant exploitation. This discovery was due to the identification of fluorspar—previously believed to be quartz—in the gangue of a vein of galena that had been repeatedly exploited. There are two mines on this deposit.

The Des Trappistes mine is about 1 mile west of Sembrancher. It was reopened and operated for galena from 1918 to 1922 but is now closed. At present neither the depth nor the extent of the vein is known. No decrease in the thickness of the vein in depth has been found. The vein is approached on three different levels at a right angle and followed lengthwise for several hundred meters. It is on the average 1 meter (3.2 feet) thick, but in places it widens to 3 meters (9.8 feet). The length of the approaches is about 250 meters (820 feet), and that of the galleries about 300 meters (984 feet). The three levels are connected by pits and stairways. The deposit, as disclosed by the excavations, measures about 12,500 cubic meters (16,349 cubic yards), of which about 10,000 cubic meters (13,079 cubic yards) is exploitable. If the average content of fluorspar is 80 per cent, of galena 3 per cent, and of other minerals (quartz, calcite, zinc blende, copper pyrite) 17 per cent, the deposit would supply 8,000 cubic meters (10,664 cubic yards) or 12,500 metric tons of fluorspar and 300 cubic meters (392 cubic yards) or 2,250 metric tons of galena.

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[6] Carlson, H. E., American vice consul in charge, Christiania, Norway, letter dated Feb. 9, 1923.
[7] Holland, Philip, American consul, Basel, Switzerland, letter dated Jan. 29, 1923.

The Tête des Éconduits mine, about 1¼ miles northwest of the Des Trappistes mine, has been closed for many years. It was originally exploited for galena. Fluorspar appears in this mine in five strata of a combined thickness of 1.45 meters (4.8 feet); the intervening layers of sericite gneiss have a combined thickness of 1.8 meters (5.9 feet). The pit follows one of the veins, which consist of white fluorspar with traces of galena. No estimate has been made of the quantity of fluorspar it will yield.

The veins of both mines lie in conformity with the granite and porphyritic gneiss of the northeast end of the Mont Blanc group of mountains, trending N. 40° E. The veins are composed of galena, fluorspar, and a small quantity of silver. The white fluorspar is coarsely crystalline, granular, and brittle, crumbling easily into splintery fragments. In the earlier descriptions it was termed quartz, feldspar, and baryta. Quartz appears here and there in pockets and in strips. In some places fluorspar surrounds calcite crystals; in others small quantities of brown zinc blende and some iron pyrite are found; and a few show some copper pyrites.

An analysis of the fluorspar made at the mining office of the Mineralogical Petrographic Institute of the Technical University at Zurich gave 45.95 per cent of calcium, 43.65 per cent of fluorine, and 10.35 per cent of silica. The material consists therefore of 89.6 per cent of fluorspar and 10.35 per cent of quartz.

The facilities for transportation are excellent. Future exploitation is favored by the extensive and advantageously located galleries and by the uniformity of the vein. Galena and fluorspar can be easily separated by hand or by washing. The fluorspar is of greater economic value than the galena and can be used as an equivalent substitute for German and French fluorspar.

The consumption of fluorspar in Switzerland is small, there being no open-hearth steel manufacture in the country. The glass factories and iron foundries use minor quantities of fluorspar, which is obtained from France and Germany. This fluorspar is imported in lumps containing from 90 to 97 per cent of calcium fluoride, as the freight is much cheaper on these lumps than on the material in the state in which it comes out of the mine.

The present price of fluorspar loaded on railway cars at the mines in Germany is 29.60 francs a metric ton. This price includes a Swiss agent's commission of 10 per cent. The freight to the German railway station at Basel is about 7.40 francs a metric ton.

PRODUCTION, BY COUNTRIES

Fluorspar produced by countries, 1919–1923, in metric tons

Country	1919	1920	1921	1922	1923
United States	125, 454	169, 441	31, 715	128, 453	109, 939
Canada	4, 593	10, 192	5, 025	4, 085	113
Great Britain	37, 452	55, 561	23, 508	33, 343	49, 818
Spain	280	416	176	392	(a)
France	4, 894	8, 997	5, 776	(a)	(a)
Italy	900	810	1, 600	1, 395	3, 362
Norway	560	----------	----------	----------	(a)
Australia:					
New South Wales	2, 046	1, 213	----------	----------	(a)
Queensland	----------	613	545	----------	----------
Victoria	319	13	199	----------	(a)
Germany:					
Bavaria	6, 396	6, 272	7, 210	(a)	(a)
Saxony	2, 906	2, 918	4, 763	(a)	(a)
Prussia	10, 444	7, 339	11, 989	(a)	(a)

[a] Figures not yet available.

CRYOLITE

Cryolite occurs in commercial quantities only in Greenland, at Ivigtut. According to Ball,[8] it is mined in a great open cut, the vertical walls of which stand remarkably well. Air drills are used, and the cryolite is shot with black powder down in benches from the top, the effort being to shatter the product as little as possible. It is then hand cobbed and thrown into wheelbarrows, the waste being separated from fairly pure cryolite in the process. The cryolite is then wheeled to sorting platforms, where several men scoop water over it and others hammer off impurities and sort it by hand. Three classes of ore are thus produced—one for the United States, the "black" (dark brownish-gray translucent) cryolite, which contains approximately 93 per cent of cryolite, and two for Denmark, both of white cryolite said to be 95 and 99 per cent pure. The ore is then trammed to a hoist and after hoisting is trammed to the pier and placed in large, carefully alined, straight-walled piles according to its grade.

Formerly two-thirds of the product was sold to the Pennsylvania Salt Co. and the other third went to Copenhagen, but at present these relative proportions are reversed. Of the cryolite shipped to the United States the greater part is now used as a flux in the metallurgy of aluminum and for opaque glass. In aluminum metallurgy in this country the mineral is rapidly being supplanted by artificial cryolite.

The imports of cryolite into the United States in 1923, according to the Bureau of Foreign and Domestic Commerce, amounted to 6,375 long tons, valued at $319,959, or $50.19 a ton, as compared with 3,899 long tons, valued at $196,302, or $50.35 a ton, in 1922.

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[8] Ball, S. H., The mineral resources of Greenland: Econ. Geology, vol. 17, pp. 17–31, 1922.

FUEL BRIQUETS

By W. F. McKenney[1]

PRODUCTION

Under the stimulus of active demand in the early months of 1923, the fuel-briquetting industry established a new high record of production. The total output was 696,810 net tons, an increase over the previous high record, made in 1922, of 77,385 tons, or 12 per cent. The output was 46 per cent greater than in 1918 and 23 per cent greater than in 1920. The curve in Figure 1 shows that the trend of total production has been steadily upward during the last 16 years with but four interruptions.

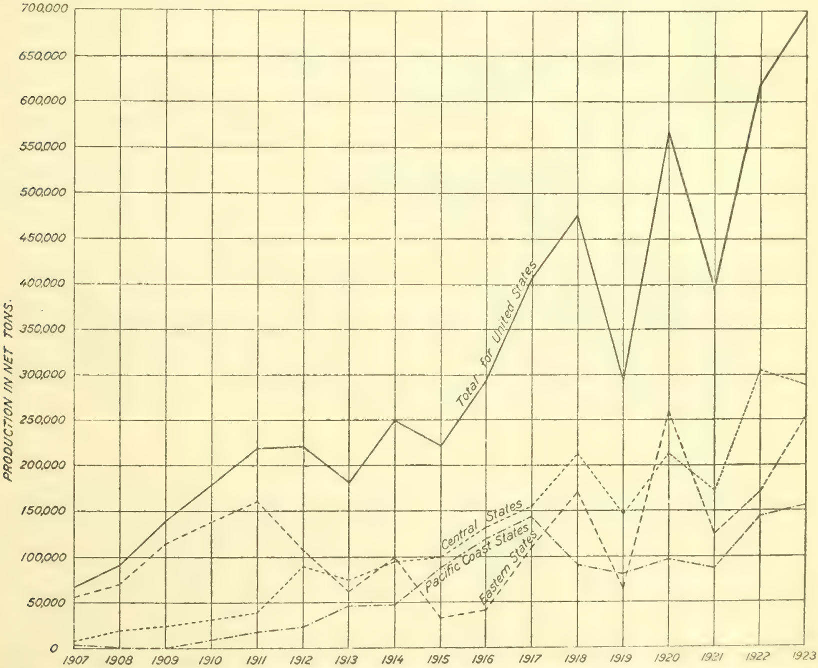

FIGURE 1.—Fuel briquets produced in the Eastern, Central, and Pacific Coast States and in the United States, 1907–1923.

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[1] The tables in this report were prepared by Miss J. M. Corse, of the United States Geological Survey, who has compiled the statistics on fuel briquets since 1911.

Fuel briquets produced in the United States in 1922 and 1923 [a]

	1922		1923	
	Net tons	Value	Net tons	Value
Eastern States	170,152	$1,177,275	252,166	$1,678,038
Central States	305,593	2,755,721	289,314	2,705,019
Pacific Coast States	143,680	1,511,930	155,330	1,515,641
	619,425	5,444,926	696,810	5,898,698

[a] List of producers shown on page 47.

The outstanding feature of 1923 was an increase of 48 per cent in production at plants in the Eastern States. These plants serve territory where anthracite is used generally as household fuel, and much of the gain may be attributed to the shortage of domestic sizes of anthracite during the winter of 1922–23. It may also be true that some consumers who obtained briquets as a substitute for their regular fuel at that time found them suitable for their purposes and continued to use them during the following winter, to avoid paying the higher prices asked for anthracite. In the Pacific Coast States there was an increase of 8 per cent. In the Central States the production was approximately 5 per cent less than in 1922.

Fuel briquets produced in the United States in 1918–1923

Year	Net tons	Value	Year	Net tons	Value
1918	477,235	$3,212,793	1921	398,949	$3,632,301
1919	295,734	2,301,054	1922	619,425	5,444,926
1920	567,192	4,623,831	1923	696,810	5,898,698

Of the States producing briquets, Wisconsin, which has two plants, stood first, producing 40 per cent more than any other State. The greatest gain over the preceding year occurred in Pennsylvania, where there was an increase of 71 per cent. The combined production in Wisconsin and Pennsylvania constituted more than 67 per cent of the total output for the country.

VALUE

The value of the briquets manufactured in 1923 was $5,898,698, an increase compared with the value in 1922 of 8 per cent. The average value per ton f. o. b. plant, however, declined from $8.79 to $8.47. This was the second decrease in as many years, and it carried the average value per ton to a level not much above that of 1920. The failure of the total value to increase in the same ratio as the total production and the pronounced decrease in the average value per ton are explained by the fact that the low-priced product of Pennsylvania formed a much larger part of the total than in 1922. A better idea of the trend in prices of briquets may be gained from the following table, which shows the average value per ton at the plants in Pennsylvania and the Central States during the last 13 years.

Average value per ton (f. o. b. plant) of briquets produced in Pennsylvania and the Central States, 1911–1923

Year	Pennsylvania	Central States
1911	$2.37	$4.34
1912	2.68	4.47
1913	2.65	4.92
1914	2.48	4.83
1915	2.90	4.26
1916	3.83	4.73
1917	3.15	6.81
1918	$4.11	$8.17
1919	4.17	8.47
1920	5.60	9.23
1921	6.14	9.28
1922	5.93	9.02
1923	5.95	9.35

In 1923, as in previous years, the value at the plant was lowest in the Eastern States, where materials suitable for the manufacture of briquets are available at low cost and where there is keen competition with other fuels. For the Eastern States the average value per ton f. o. b. plants was $6.65, for the Central States it was $9.35, and for the Pacific Coast States it was $9.76. These figures, however, do not indicate the prices paid by consumers. Some of the plants are hundreds of miles from the localities in which their product is consumed, and to the value at the plant must be added the cost of transportation and the margin of the wholesaler or the retailer and sometimes both. Complete information as to the retail prices of briquets is not available, but reports of five producers who sold a part of their product direct to consumers showed a range of prices from $6.26 to $15.75 a net ton. Practically all the briquets sold in this manner were purchased by consumers in the neighborhood of the plants. Customers at distant points would have to pay freight charges. At four of these plants retail prices showed decided seasonal fluctuation as a result of summer discounts. At two the prices were gradually lowered, reached the lowest point in June, and rose during the remainder of the year. At two other plants prices were reduced in April and remained the same until September, when they were raised to the level of the first quarter of the year. At the fifth plant prices were reduced in May, June, and August and then remained the same during the rest of the year. The differentials between summer and winter prices varied greatly at the different plants and were $0.88, $1.00, $1.74, and $3.54. Customers who purchased their supply at the summer prices saved 1, 2, 6, and 27 per cent, respectively, of the prices that they would have had to pay in the winter.

DISTRIBUTION

In its questionnaire for 1923 the Geological Survey requested information on the methods of disposing of the briquets. The replies show that two plants sold to wholesalers only, four sold to retailers only, and eight sold direct to consumers as well as to wholesalers or retailers or both. No plant sold its entire output direct to consumers.

Fuel briquets sold in the United States in 1923, in net tons

	Sold to—			Total	Average value f. o. b. plants
	Wholesalers	Retailers	Consumers		
Eastern States	101,166	133,324	12,487	246,977	$6.65
Central States	254,732	25,555		280,287	9.35
Pacific Coast States		59,778	93,234	153,012	9.76
	355,898	218,657	105,721	680,276	8.47

In 1923 the total quantity of briquets sold by the producers was 680,276 tons, of which 52 per cent went to wholesalers, 32 per cent to retailers, and 16 per cent direct to consumers. These briquets were widely distributed and were shipped into no less than 30 States and the Dominion of Canada. The entire output of the plants in California and Washington was consumed within the States of origin. The map in Figure 2 shows the States into which each of the eight producing States shipped its product.

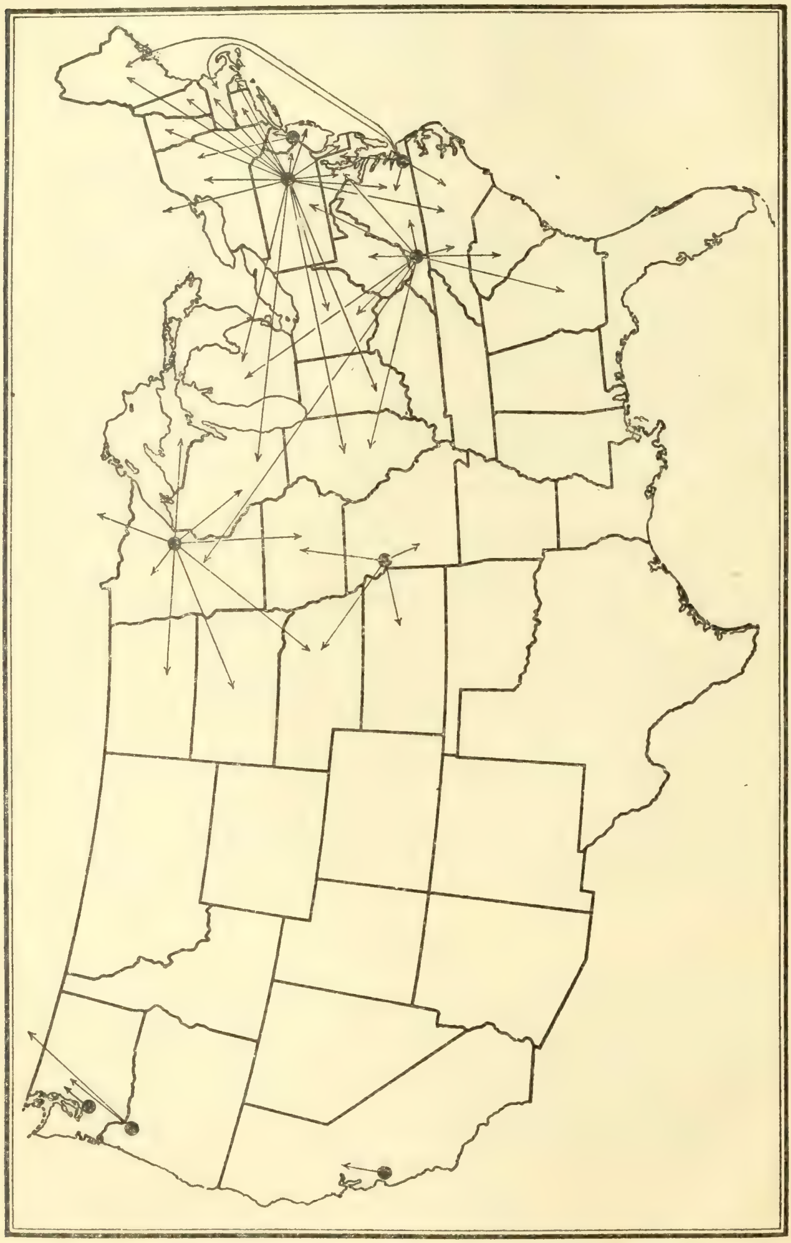

FIGURE 2.—Distribution of fuel briquets in 1923

RAW MATERIALS AND BINDERS

Of the 14 plants that reported production in 1923, five used anthracite culm or fines as fuel constituent, two semianthracite, two a mixture of anthracite culm or fines and bituminous slack, one semibituminous slack, one bituminous slack, one a mixture of bituminous slack and subbituminous coal, and two carbon residue from the manufacture of oil gas. The total quantity of raw fuel used was 682,490 net tons, of which 49 per cent was anthracite and semianthracite, 33 per cent semibituminous and bituminous slack, and 18 per cent subbituminous coal and oil-gas residue. Owing to the fact that the quantity of binders added was larger than the weight of moisture expelled, there was a net gain of 14,320 tons during the process of manufacture.

There were no radical changes in binders in 1923. Two plants used no binder; six used asphaltic pitch; one, coal-tar pitch; one, a mixture of asphaltic and coal-tar pitch; one, mixed pitches, starch, and sulphite; one, sulphite liquor; one, asphaltic pitch and "other binder"; and one, patent binder. Asphaltic pitch gained favor as a binder, and two plants discarded other binders to use it. Asphaltic pitch alone was used in 60 per cent of the briquets produced. Asphaltic pitch and coal-tar pitch either alone or in compounds with other binders were used in more than 88 per cent of the output.

Raw fuels used in making briquets in the United States, 1919–1923, in net tons

Fuel	1919	1920	1921	1922	1923
Anthracite culm and fine sizes and semianthracite	118, 595	356, 877	190, 964	254, 563	331, 102
Semibituminous and bituminous slack and coke	[a] 97, 387	[a] 125, 506	121, 925	235, 542	[a] 225, 508
Lignite, subbituminous coal, and oil-gas residue	80, 383	89, 656	[b] 85, 352	[b] 123, 339	[b] 125, 880
	296, 365	572, 039	398, 241	613, 444	682, 490

[a] Includes no coke.

[b] Includes no brown lignite.

BRIQUETTING PLANTS IN THE UNITED STATES

Of the 14 briquetting plants that were in operation in 1922, 13 were active in 1923, and the plant of the Virginia Fuel Corporation, at Portsmouth, Va., commenced operations. The plant of the Clinchfield Carbocoal Corporation, at South Clinchfield, Va., was idle throughout the year.

As the successful operation of a briquetting plant depends upon its ability to meet in competition other forms of fuel, it is apparent that plant locations must fulfill certain requirements. Briefly, these requirements are a readily available supply of low-priced raw fuel, an accessible market that demands high-grade fuel, and lower transportation costs than those prevailing on the principal competitive coals. For these reasons most of the briquetting plants now in existence have been located in towns near coal fields that are close to well-populated areas.

Figure 3 shows the location of each of the plants that were operated in 1923 and its relation to the coal fields. Of the fourteen plants, six are in or very close to the anthracite field of Pennsylvania, one near the southwestern Virginia district, one near the coal fields of

Missouri, and one at almost the center of the Washington fields. Of the five plants not located close to coal-producing centers, two use no coal, substituting for it the carbon residue from the manufacture of oil gas, two utilize the fine sizes resulting from the rescreening of coal received at the head of the Lakes, and one uses raw coal that has been carried to a point near tidewater.

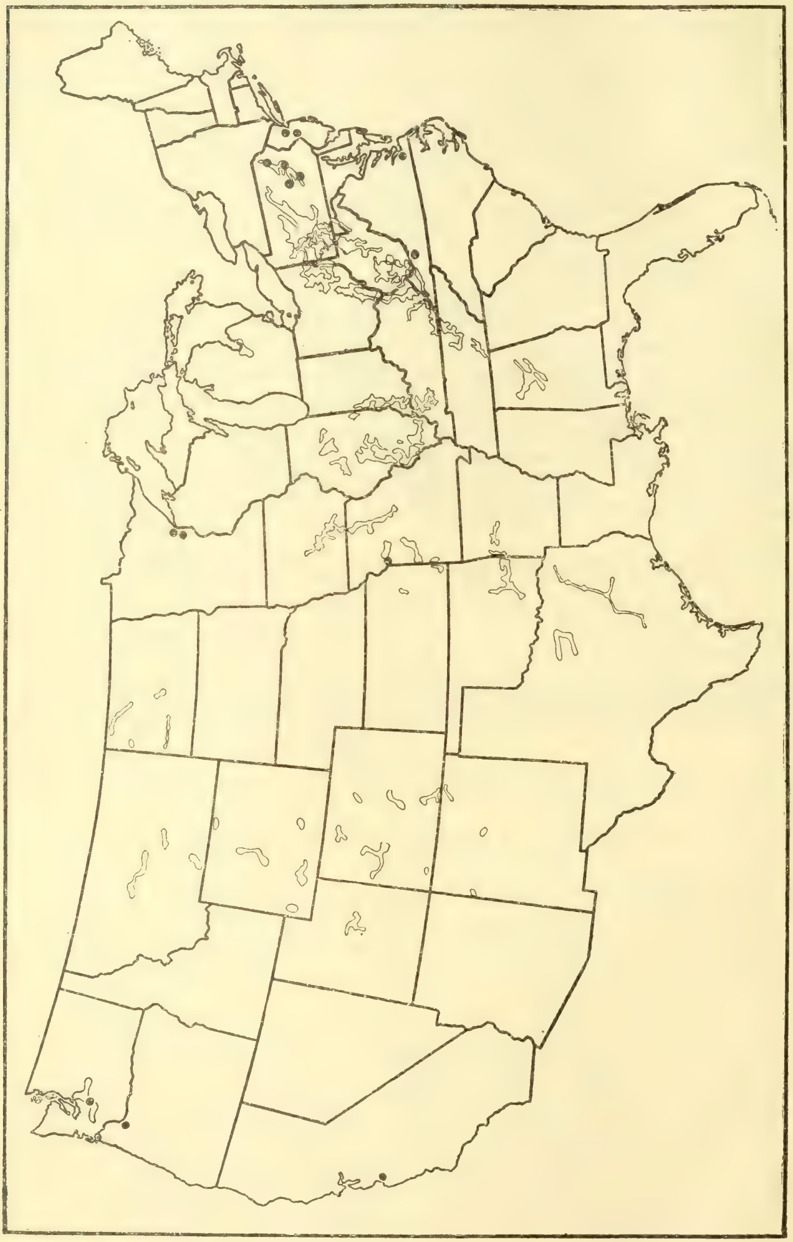

FIGURE 3.—Location of fuel-briquetting plants in the United States in relation to coal fields.

Briquetting plants operated in the United States in 1923

Group and State	Name and address of operator	Location of plant	Date put in operation	Raw fuel used
Eastern States:				
New Jersey	Anthracite Manufacturing Corporation, 520 Brunswick Avenue, Trenton, N. J.	Trenton	1918	Anthracite.
Do	Burnrite Coal Briquette Co., 543 New Jersey Avenue, Newark, N. J.	Newark	1920	Do.
Pennsylvania	American Briquet Co., 402 Land Title Building, Philadelphia, Pa.	Lykens	1920	Do.
Do	Anthracite Briquette Co., Sunbury, Pa.	Sunbury	1919	Do.
Do	Lehigh Coal & Navigation Co., 437 Chestnut Street, Philadelphia, Pa.	Lansford	1909	Do.
Do	Scranton Anthracite Briquette Co., Dickson City, Pa.	Dickson City	1907	Anthracite and bituminous slack.
Virginia	Delparen Anthracite Briquette Co., Parrott, Va.	Parrott	1915	Virginia semianthracite.
Do	Virginia Fuel Corporation, 930 High Street, Portsmouth, Va.	Portsmouth	1923	Bituminous slack.
Central States:				
Missouri	Standard Briquet Fuel Co., 319 North Fourth Street, St. Louis, Mo.	Kansas City	1909	Arkansas semianthracite.
Wisconsin	Berwind Fuel Co., 122 South Michigan Avenue, Chicago, Ill.	Superior	1912	Semibituminous slack.
Do	Stott Briquet Co., Merchants National Bank Building, St. Paul, Minn.	do	1909	Anthracite fines and bituminous slack.
Pacific Coast States:				
California	Los Angeles Gas & Electric Corporation, 645 South Hill Street, Los Angeles, Calif.	Los Angeles	1905	Carbon (petroleum residue).
Oregon	Portland Gas & Coke Co., Gasco Building, Portland, Oreg.	Portland	1913	Do.
Washington	Pacific Coast Coal Co., 612 L. C. Smith Building, Seattle, Wash.	Renton	1914	Bituminous slack and subbituminous coal.

WORLD'S PRODUCTION

The following table, prepared by W. I. Whiteside, of the United States Geological Survey, presents the information now available on the world's production of fuel briquets. The figures are taken in the main from official sources, but some have been obtained from trade publications and are subject to revision upon receipt of more accurate or complete data. Such revision has been made in some of the figures previously published for years prior to 1922. It is not expected that further revisions for those years will be necessary.

It is now estimated that the world's production of fuel briquets in 1923 was approximately 37,500,000 metric tons, a decrease of approximately 14 per cent compared with the output in 1922. Of this quantity, 34,818,000 tons was produced by nine countries for which reports have been received. For the four countries which are shown for 1922 but which have not yet issued figures for 1923 conservative estimates have been included. The principal factor in the decline was a sharp decrease in German production. Of the total world's output, the United States contributed 1.7 per cent.

World's production of fuel briquets, 1918–1923

[In metric tons of 2,204.6 pounds]

Country [a]	1918	1919	1920	1921	1922	1923
Algeria	(b)	19,000	31,000	33,000	(b)	(b)
Belgium	1,141,000	2,548,000	2,846,000	2,677,000	2,497,000	1,931,000
Czechoslovakia	(c)	229,000	176,000	269,000	179,000	273,000
France	(b)	2,839,000	4,012,000	4,204,000	2,804,000	3,056,000
Germany: Coal	5,484,000	4,081,000	4,894,000	5,686,000	5,563,000	1,725,000
Lignite	23,040,000	19,611,000	23,882,000	28,243,000	29,466,000	26,856,000
Saar	(d)	(d)	33,000	28,000	(b)	(b)
Netherlands	504,000	584,000	634,000	585,000	626,000	(b)
Poland	(d)	(d)	(d)	(d)	(e)	308,000
Russia	16,000	(b)	(b)	(b)	(b)	(b)
Spain	410,000	587,000	742,000	733,000	676,000	(b)
United Kingdom	1,885,000	2,094,000	2,332,000	1,081,000	1,354,000	(b)
United States	433,000	268,000	515,000	362,000	562,000	632,000
Venezuela	(b)	(b)	2,000	2,000	7,000	(b)

[a] In addition to the countries shown in the table, Canada reports 36,636 tons produced in 1923; others manufacturing briquets, for which figures have not been obtained, are Hungary (production unimportant), Indo-China, and Switzerland.

[b] Data not available.

[c] Prior to 1919 the briquet production of the present Czechoslovakia was credited to the old Austrian Empire. Figures of production for Austria are not available for 1918.

[d] Included with Germany.

[e] The production of briquets in Polish Upper Silesia in 1922 was 198,000 tons. This figure can not be included in the world's total because the output from January to May is already included in the German production.

SLATE

By G. F. Loughlin and A. T. Coons

GENERAL CONDITIONS

Continued recovery of the slate industry from the recent period of depression is indicated by an increase of 20 per cent in quantity and 32 per cent in value in total sales made in 1923 compared with those made in 1922. The quantity sold amounted to 726,800 short tons, valued at $12,076,624. The value is the largest ever recorded and reflects the continued high cost of production as compared with costs before the war. The trend in the use of slate is represented in Figure 4, which expresses the annual sales of different slate products in a common unit, short tons. The increase in sales since 1921 has been common to all slate products, but those of slate granules for surfacing prepared roofing have increased the most rapidly. Roofing slate has regained only a very small part of the ground lost since 1910, whereas total mill stock is but 13 per cent less than its previous maximum in 1913.

The amount of ground lost by roofing slate is really more than is indicated by Figure 4, as the country has been growing rapidly, and a considerable increase in slate would have been necessary for a product to keep pace with this growth. This condition is illustrated in the following table:

Ratio of sales of slate and structural materials to population, 1900–1923

Year	Population (millions)	Slate (short tons per million people)					Structural materials [a] (short tons per million people)
		Mill stock	Roofing	Granules	Mill stock and roofing	Mill stock, roofing and granules	
1900	76	490	5, 300	(b)	5, 790	(b)	500, 000
1910	92	730	4, 620	(b)	5, 350	(b)	1, 600, 000
1914	98	740	3, 510	(b)	4, 250	(b)	1, 600, 000
1920	106	570	1, 260	2, 540	1, 830	4, 370	1, 310, 000
1921	108	530	1, 090	2, 150	1, 620	3, 770	1, 340, 000
1922	109	560	1, 490	3, 490	2, 050	5, 540	1, 600, 000
1923	111	690	1, 540	4, 160	2, 230	6, 390	2, 000, 000

[a] Includes cement, clay products, gypsum, lime, sand and gravel, sand-lime brick, slate, and stone.
[b] Figures for granules not compiled prior to 1916.

Competition with other roofing materials has grown rapidly during the last 20 years. Furthermore, the location of productive quarries of roofing slate almost entirely in the northeastern part of the country has made producers dependent in recent years upon unfavorable freight rates and general transportation conditions for extending their markets. A greater reason for the restriction of the roofing-slate industry, however, has been the lack of concerted action by producers to see that the natural merits of slate were duly recognized and that the methods of handling the product from the time it left the quarry until it was in place on the roof did not offset these merits and unjustly injure the reputation of slate. The gains in sales during 1922 and 1923 are due in considerable part to the correction of abuses in the handling of slate as well as to aggressive selling campaigns and instructive advertising and more favorable freight rates. It is noteworthy that these gains have increased the ratio of sales to population compared with that in 1920 to 1922. The ratio in 1923, however, was only one-third of that in 1910. One of the obstacles to growth at present is a shortage in experienced slate roofers, and the industry is taking measures to make up this shortage, so that roofers can fill contracts promptly.

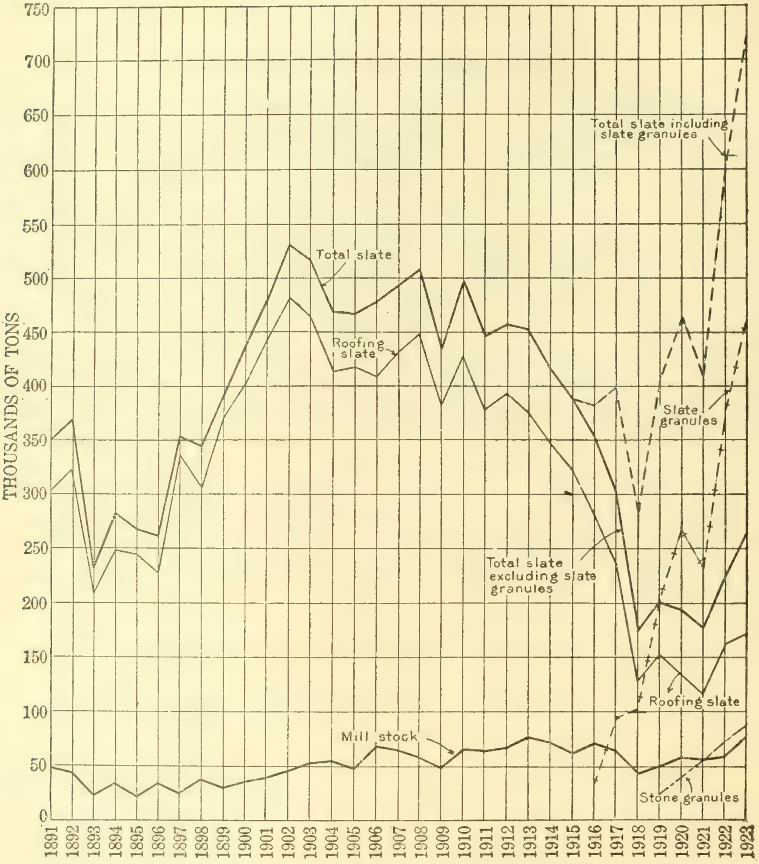

FIGURE 4.—Quantity of slate sold in the United States, 1891–1923, by uses, in short tons (approximate), and quantity of stone granules sold in the United States, 1919–1923, in short tons

Sales of mill stock also have been affected by keen competition but have been much more satisfactory than those of roofing slate.

Although they fluctuated considerably, their ratio to population made a large net gain in 1910 as compared with 1900 and held its own in 1914. The decline in ratio during the war was not surprising, but recovery lagged and has not yet reached a maximum. Mill stock, particularly structural and sanitary and electrical slate, has also benefited by the measures taken by producers, dealers, and others interested to improve conditions of production, milling, marketing, and utilization.

The output of slate granules used principally as a surfacing material for manufactured roofing has shown a remarkable increase since statistics were first compiled in 1916. Pulverized slate or "flour" is used as a filler in roofing mastic, in road asphalt, and to some extent in rubber, oilcloth, and linoleum. The granules used as surfacing material in turn are in competition with granules crushed from various kinds of stone, principally greenstone (altered diabase), most of which has a distinct slaty cleavage. The output of these stone granules is shown in Figure 4. The manufacture of slate granules is a new industry rather than an expansion of the old slate industry, as the granules have been made mostly from slate not suitable for roofing shingles or mill stock; but old slate dumps have been utilized to a small extent. The growth of the industry has been steady except in 1921, and its ratio of sales to population has also increased.

To present a fairer idea of the trend in sales of slate, sales of the principal nonmetallic structural mineral products as a whole are shown in the table on page 49. These products are all for which satisfactory figures are available and represent the bulk of the tonnage. Collectively they should approach a constant ratio more nearly than any single product, and it is interesting to note the predominance of the ratio 1,600,000 tons per million. The lower figures for 1920 and 1921 represent the slump in building activities that continued for a time after the war, and the high figure (estimated) of 1923 represents compensating activity.

The value of the different slate products has increased much more rapidly than their quantity, as may be seen from Figure 5.

Sales of roofing slate increased 6 per cent in quantity and 13 per cent in value in 1923. The average price per square was $9.03, 54 cents more than in 1922.

Total sales of mill stock increased about 20 per cent over those of 1922 in quantity and 44 per cent in value. The diagram on page 53 (fig. 6) shows the total mill-stock production since 1890 and the subdivision into the different classes of milled products for which figures are available. Slate for blackboards and bulletin boards forms the the largest part (40 per cent) of the mill stock sold. In 1923 this product showed an increase of about 26 per cent in quantity and 35 per cent in value. The largest increase in sales of mill stock was in that sold for electrical purposes, which increased 60 per cent. Sales of mill stock for structural and sanitary use increased 16 per cent; sales of billiard-table material 38 per cent, and sales for grave vaults and covers 13 per cent. Only material sold for school slates decreased (23 per cent). It is difficult to obtain from the producers exact figures showing the use for which their mill stock was sold, as the use of some of it may not be determined until it is sold by the

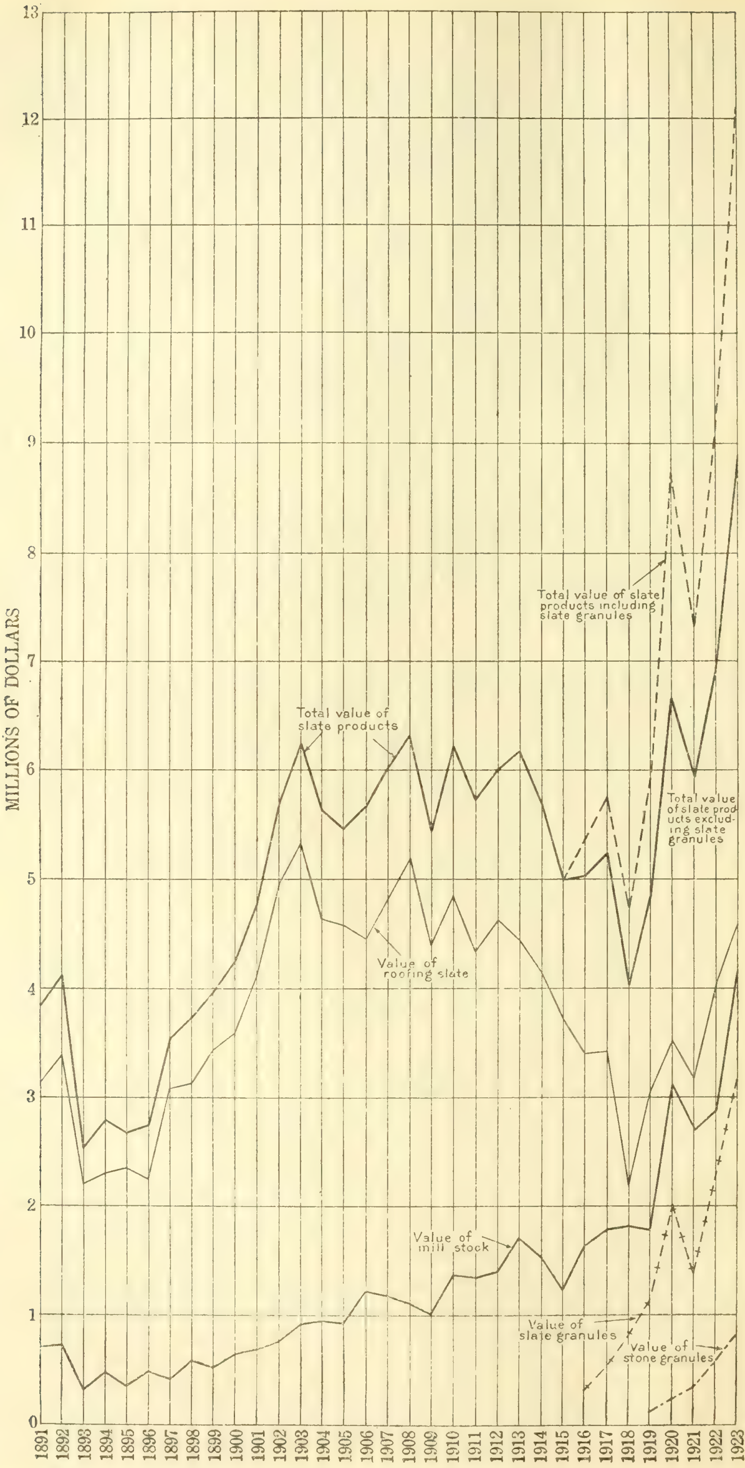

FIGURE 5.—Value of slate sold in the United States, 1891–1923, by uses, and value of stone granules sold in the United States, 1919–1923

jobber. The division given, however, represents the best information available.

Sales of slate flagstones have been increasing in the last few years. These are sold chiefly for walks in gardens and on lawns where special artistic effects are desired. A small amount of slate, chiefly from quarries in Maine, is sold annually for tombstones.

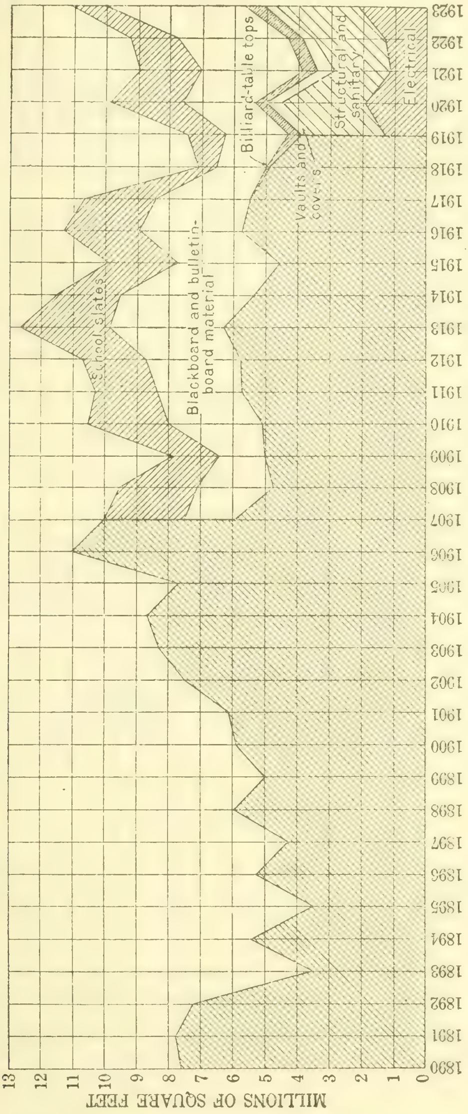

FIGURE 6.—Total sales of mill stock and of classes of mill stock for which figures are available, 1890-1923, in square feet

Sales of slate roofing granules and "flour" increased 22 per cent in 1923. Granules were first manufactured from the red and green slates of New York and Vermont but are now made also from the green slates of Georgia and Tennessee and the gray and bluish-black slates of Pennsylvania and Virginia. Yellow-brown or rusty-colored granules are also being manufactured. In 1923 the crushed slate reported included 8,022 short tons of pulverized slate or "flour," valued at $64,359. Other stone, chiefly "greenstone" or altered diabase, crushed into granules in 1923 amounted to about 86,000 tons, valued at $630,000.

The demand for all products of slate during the year was with practically all the quarrymen much better than in 1922. Most of the school slates manufactured are shipped to foreign countries, and the unsettled social and political conditions abroad have evidently decreased the demand for this product. Higher average prices were reported by most of the operators during the year, although a few reported no changes in price. Wages remained unchanged in some of the quarries, but slight increases, ranging from 5 to 15 per cent, were more generally reported. Common labor was reported as scarce, and lack of skilled labor has become one of the serious problems confronting both the slate-quarry operators and all the different branches of trade connected with the slate industry. Specially trained men are necessary for the proper handling of slate in the quarries, in the splitting yards, in the mills, and in applying the slate as roofing.

Transportation difficulties were less than in previous years, and better rates were obtained from the railroads. There were few strikes in the quarries and mills. The number of quarry companies reporting operation in 1923 was 120, or 16 more than in 1922. In New York and Vermont there are many small quarries intermittently worked for roofing slate on a small scale. The product of these quarries is generally sold with the output of some of the larger quarries, and much of it consists of "freaky" or odd-colored slate of unusual size or thickness for use in special pieces of work.

As slate from many of the small producers is sold by the larger producing companies, the possibility of duplication of returns must be considered in the compilation of operators' reports. Special care has been taken to avoid duplication in compiling the following figures.

PRODUCTION

The following tables show sales of slate by uses from 1919 to 1923. Approximate figures for earlier years may be interpolated from Figures 4, 5, and 6. In approximating the tonnage for the different slate products given in the following table a specific gravity of 2.75 has been used as the basis of calculation, and a thickness corresponding to an average for each product. The total quantity and value given for each use are the totals of the reports of the quarrymen (not the selling agents), and the value f. o. b. quarry or nearest point of shipment is given. It has been suggested that some of the mill stock finds its ultimate use for purposes other than reported by the quarrymen, but the Survey has no means of verifying this suggestion.

Slate sold in the United States, 1919–1923, by uses

Year	Roofing slate			Mill stock			Other uses [b] (value)	Total value [a]
	Squares (100 sq. ft.)	Value [a]		Square feet	Value [a]			
		Total	Average		Total	Average		
1919	454, 337	$3, 085, 957	$6. 79	7, 466, 000	$1, 782, 793	$0. 24	$1, 161, 898	$6, 030, 648
1920	396, 230	3, 524, 658	8. 90	9, 910, 000	3, 147, 281	. 32	2, 054, 503	8, 726, 442
1921	348, 085	3, 197, 745	9. 19	8, 970, 000	2, 719, 723	. 30	1, 404, 538	7, 322, 006
1922	479, 243	4, 069, 761	8. 49	9, 276, 800	2, 899, 195	. 31	2, 207, 828	9, 176, 784
1923	507, 587	4, 582, 535	9. 03	11, 109, 480	4, 159, 644	. 37	3, 334, 445	12, 076, 624
Percentage of increase, 1923	5. 9	12. 6	6. 4	19. 8	43. 5	19. 4	51. 0	31. 6

[a] F. o. b. at point of shipment.

[b] Chiefly slate granules.

Roofing slate, mill stock,[a] and slate granules (including "flour") sold in the United States in 1922 and 1923, by uses

Use	1922			1923				
	Quantity	Value [b]		Quantity	Value [b]		Percentage of increase or decrease	
		Total	Average		Total	Average	Quantity	Value
Roofing squares	479, 243	$4, 069, 761	$8. 49	507, 587	$4, 582, 535	$9. 03	+5. 9	+12. 6
Approximate equivalent in short tons	161, 700	------	------	171, 300	------	------	------	------
Electrical square feet	1, 363, 300	996, 322	. 73	2, 182, 890	1, 754, 717	. 80	+60. 1	+76. 1
Approximate equivalent in short tons	9, 700	------	------	15, 600	------	------	------	------
Structural and sanitary square feet	2, 131, 800	750, 653	. 35	2, 479, 620	894, 757	. 36	+16. 3	+19. 2
Approximate equivalent in short tons	15, 300	------	------	17, 730	------	------	------	------
Grave vaults and covers square feet	400, 100	87, 763	. 22	451, 160	111, 223	. 25	+12. 8	+26. 7
Approximate equivalent in short tons	5, 700	------	------	6, 450	------	------	------	------
Blackboards and bulletin boards square feet	3, 518, 700	880, 985	. 25	4, 415, 710	1, 186, 864	. 27	+25. 5	+34. 7
Approximate equivalent in short tons	25, 100	------	------	31, 600	------	------	------	------
Billiard-table tops square feet	383, 900	141, 445	. 37	527, 680	180, 981	. 34	+37. 5	+28. 0
Approximate equivalent in short tons	2, 700	------	------	3, 770	------	------	------	------
School slates pieces	2, 766, 600	42, 027	[c] 15. 19	2, 144, 900	31, 102	[c] 14. 50	−22. 5	−26. 0
Approximate equivalent in square feet	1, 479, 000	------	------	1, 052, 420	------	------	------	------
Approximate equivalent in short tons	2, 000	------	------	1, 550	------	------	------	------
Granules short tons	379, 980	2, 177, 061	5. 73	462, 260	3, 268, 554	7. 07	+21. 7	+50. 1
Other [d] short tons (estimated)	5, 500	30, 767	------	16, 540	65, 891	------	------	------
Total (quantities approximate, in short tons)	607, 680	9, 176, 784	------	726, 800	12, 076, 624	------	+19. 6	+31. 6

[a] In 1922 the mill stock sold, including school slates, was approximately 9,276,800 square feet, valued at $2,899,195; in 1923 it was 11,109,480 square feet, valued at $4,159,644.

[b] F. o. b. at point of shipment.

[c] Average value per thousand pieces.

[d] Includes slate sold for flagging (117,754 square feet, valued at $16,906, in 1922, and 249,540 square feet, valued at $54,493, in 1923), tombstones, waste slate, and other uses not specified.

Slate sold in the United States in 1923, by States and uses

State	Operators	Roofing slate			Structural and sanitary		Electrical		Other uses [a] (value)	Total value
		Squares (100 square feet)	Value							
			Total	Average	Square feet	Value	Square feet	Value		
California	1	([b])	([b])	$12.50						([b])
Georgia	1								([b])	([b])
Maine	4	4,700	$62,202	13.23	19,130	$15,996	737,610	$670,092	$6,536	$754,826
Maryland	2	([b])	([b])	12.77					([b])	([b])
New Jersey	1	([b])	([b])	8.00						([b])
New York	15	4,475	67,741	15.14					859,657	927,398
Pennsylvania	50	300,272	2,373,125	7.90	2,300,230	776,833	676,140	453,070	1,984,642	5,587,670
Tennessee	1								([b])	([b])
Vermont	40	166,396	1,717,950	10.32	160,260	101,928	769,140	631,555	1,405,854	3,857,287
Virginia	5	28,383	321,010	11.31					([b])	[c] 321,010
Undistributed		[d] 3,361	[d] 40,507						[d] 587,926	[d] [e] 628,433
	120	507,587	4,582,535	9.03	2,479,620	894,757	2,182,890	1,754,717	4,844,615	12,076,624
Total, 1922	104	479,243	4,069,761	8.49	2,131,800	750,653	1,363,300	996,322	3,360,048	9,176,784

[a] For details see table of sales on page 55.
[b] Included under "Undistributed."
[c] Exclusive of value of granules, etc., which is included under "Undistributed."
[d] Includes output of States entered as "([b])" above.
[e] Includes also value of granules, etc., for Virginia.

IMPORTS AND EXPORTS [1]

Value of slate imported for consumption in the United States, 1918–1923

Year	Value	Year	Value
1918	$321	1921	$2,923
1919	691	1922	2,753
1920	4,512	1923	16,881

Roofing slate exported from the United States, 1922 and 1923, by countries

Country	1922		1923	
	Number of squares	Value	Number of squares	Value
Canada	8,134	$74,031	8,002	$74,357
Mexico	30	128		
Honduras			8	132
West Indies:				
Bermuda	171	1,482	5	110
Cuba	261	2,717	20	98
Trinidad and Tobago	126	1,388	108	1,031
Other British West Indies	484	2,387	135	1,296
Brazil			12	77
British Guiana	200	1,388		
Colombia	12	116		
England	402	3,041	1	25
Ireland	996	9,212		
Denmark	100	700		
Australia	124	1,221	72	657
British South Africa			25	291
New Zealand			74	706
	11,040	97,811	8,462	78,780

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[1] The figures of imports and exports were compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

The following figures for exports of slate other than roofing were collected by the United States Geological Survey from shippers of the products named:

Slate other than roofing exported from the United States in 1923, by destination

Destination	Electrical		Billiard tables		School slates		Blackboards		Total
	Square feet	Value	Square feet	Value	Cases [a]	Value	Square feet	Value	
Canada [b]	[c] 183, 768	[c] $81, 647	41, 387	$19, 721	3, 501	$30, 109	88, 817	$29, 338	$160, 815
Mexico	1, 777	1, 627			629	5, 361			6, 988
Central America	637	527	311	109	288	2, 383			3, 019
West Indies	3, 136	2, 867	5, 934	2, 110	1, 441	13, 224	2, 450	1, 104	19, 305
South America	4, 994	4, 570	2, 797	982	2, 282	18, 879			24, 431
Europe	1, 140	1, 043			1, 614	13, 363			14, 406
Africa	1, 060	1, 012			1, 086	9, 309			10, 321
Oceania	3, 160	2, 925			2, 186	18, 085			21, 010
Asia	9, 922	9, 114			8, 475	69, 698			78, 812
	[c] 209, 594	[c] 105, 332	50, 429	22, 922	21, 502	180, 411	91, 267	30, 442	339, 107

[a] Cases weigh from 130 to 165 pounds each; average is 135 pounds.
[b] There was also shipped to Canada 5,109 short tons of slate granules, valued at $38,126.
[c] Includes a small amount of structural slate.

REVIEW BY DISTRICTS

The slate report for 1922 gave for each section of the country where slate is produced a list of the producers operating slate quarries and a brief description of the slate produced and its use. The few changes that have taken place among operators in 1923 are noted in the following review by districts.

Maine district.—In Maine the quantity of slate sold increased about 36 per cent over the output in 1922. The principal product sold is electrical slate, although sales of slate for roofing, structural purposes, blackboards, tombstones, and granules were also reported. Demand was good throughout the year. Wages increased from 10 to 30 per cent, and prices from 10 to 15 per cent. Development work was carried on by all the producing companies, and a new shaft was reported as having been opened by the General Slate Co.

New York-Vermont district.—There was an increase of production of 10 per cent for both the New York and Vermont quarries in 1923. These States produce the colored roofing slates that are at present especially popular on account of the wide variety of color offered to the architect for the blending of the color of the roof with the material and environment of the house. The slate of New York is not used to any extent for mill stock. Red granules and red roofing slate are obtained only in New York, but roofing slate of the purple, green, gray, and variegated colors common to the Vermont slates are also produced in New York. Some of the slate is also sold for flagging. The Vermont quarries produce roofing slate, mill stock, and slate granules. The colors are in a wide variety and combinations of green and purple generally classed as green, unfading green, unfading mottled green and purple, weathering green (sea-green), purple, variegated, and "freak" colors. There are also black and gray varieties. The granules manufactured are generally green. In 1923 Vermont reported the largest sales of electrical slate. The purple slate is the variety most used for this product.

Pieces of slate of larger and more regular size have from time to time been used in manufacturing roofing material as inlaid slate or as slate veneer, by embedding the slate pieces in prepared material, generally of asphaltic nature. It has been stated that the Ruberoid Co., of New York, has erected a plant at Granville, N. Y., for the manufacture of a "slate shingle" in which a piece of ruberoid about 9 by 20 inches is faced with pieces of slate about 9 by 8 inches, the slate being cemented to the ruberoid. The slate used is to be of several colors supplied by the different quarries, so that a selection of any color or mixtures of colors that may be desired by the builders may be available.

Slate of all kinds was in good demand in this district. Wages and prices remained unchanged at some of the plants but increased from 5 to 15 per cent at others. A strike of five months among the slate makers was reported. There was considerable activity in both States among the operators of small quarries that furnish small amounts, generally of unusually colored or specially sized slate, to larger operators or dealers for sale. On account of the variety of colored slates found in this district much of the roofing slate commands especially high prices.

Middle Atlantic States.—Pennsylvania furnishes practically all the slate in the Middle Atlantic district, but a small amount of roofing slate is produced annually in the "Peachbottom" region of Harford County, Md., and in New Jersey. In addition to the roofing-slate quarries in Maryland mentioned in the report for 1922, a mill has been erected at Whiteford, Harford County, for the production and manufacture in 1924 of black roofing granules by the Staso Milling Co. of Chicago, Ill. Exclusive of slate granules, Pennsylvania is the largest producer of slate in the United States and also produces a greater variety of slate products than any other State, although Maine and Vermont both outrank it in the production of electrical slate. The demand for all slate products except school slates was unusually good in 1923. Although prices and wages remained the same as in 1922 at some of the quarries, there were increases of 5 to 15 per cent in both at other plants. There were few changes in the companies operating in the State from 1922. In Lehigh County the Manhattan Slate Co. (address, Slatington), Slatedale, and the Lehigh Slate Co., Slatedale, were added to the list of producers. In Northampton County the Amalgamated Slate Co. (address, Easton) operated the Genuine Washington and Provident quarries at Berlinsville; the Bangor Slate Co. operated the Bangor Peerless quarry at Bangor; the Banner Slate Co. (address, Slatington) operated the Montgomery Slate Co.'s quarries at Danielsville; Bray & Parsons, East Bangor, started operations in September; the Hard-Vein Slate Co. (address, Easton) started the development of a quarry at Edelmans; and the Old Bangor Slate Co. (address, Easton) resumed operations at Bangor. Development work and quarry and mill improvements were reported by many of the operators. There was a considerable lack of both common and skilled labor and a few short strikes among the workers during the year. The sales of slate in 1923 according to the location of the plants and uses of the slate are given in the following table:

Slate sold in Pennsylvania in 1923, by counties and uses

County	Operators	Roofing slate			Mill stock			
		Squares (100 square feet)	Value		Structural and sanitary [a]		Electrical	
			Total	Average	Square feet	Value	Square feet	Value
Berks, Lancaster, Northampton,[b] and York	4	----------	----------	------	----------	----------	----------	----------
Lehigh	13	22, 243	$171, 610	$7. 72	57, 099	$27, 086	341, 212	$205, 768
Northampton	33	278, 029	2, 201, 515	7. 92	2, 684, 261	858, 723	334, 928	247, 302
	50	300, 272	2, 373, 125	7. 90	2, 741, 360	885, 809	676, 140	453, 070
Total, 1922	46	283, 365	2, 076, 585	7. 33	2, 408, 720	761, 935	422, 310	231, 274

County	Operators	Mill stock—Continued				Other [c]	Total value
		Blackboards and bulletin boards		School slates			
		Square feet	Value	Square feet	Value		
Berks, Lancaster, Northampton,[b] and York	4	----------	----------	----------	----------	$496, 933	$496, 933
Lehigh	13	543, 367	$106, 883	764, 860	$21, 016	565	532, 928
Northampton	33	3, 872, 213	1, 079, 443	311, 360	10, 086	[d] 160, 740	[d]4, 557, 809
	50	4, 415, 580	1, 186, 326	1, 076, 220	31, 102	658, 238	5, 587, 670
Total, 1922	46	3, 518, 218	880, 596	2, 766, 609	42, 027	331, 877	4, 324, 294

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[a] Includes slate for grave covers and vaults.

[b] For roofing granules.

[c] In 1922 includes 328,845 square feet of billiard-table material, valued at $119,209, and 30,673 short tons of granules and "flour," valued at $196,915; and in 1923 454,810 square feet of billiard-table material, valued at $148,138, and 68,550 short tons of granules and "flour," valued at $496,933.

[d] Exclusive of value of roofing granules, which is included in first entry above.

SHIPMENTS

In 1923 an attempt was made for the first time to collect statistics of the initial shipments of slate from the quarry districts to the different States. The collection of these statistics was undertaken chiefly at the request of the National Slate Association. The localization of the slate deposits in the most thickly populated part of the United States makes the matter of transportation to markets in other areas where the development of cities and towns is steadily increasing one of considerable importance to the slate trade. Transportation and freight rates have long been a retarding factor in the slate industry, and the better rates from the Vermont quarries that have recently been obtained have been given as one of the principal reasons for the increased activity of the slate trade in this State. It would therefore seem that a statement showing the location and size of markets already obtained would suggest where other markets may be available. The total quantity of slate quarried annually is small, compared with that of many other mineral products, and no individual company produces an output of any considerable magnitude. In order, therefore, to facilitate the marketing of the product large quarry companies and joint selling agencies act as distributors for many of the quarries and also as buyers for the slate trade. For this reason many of the quarry operators have no record of the ultimate destination of their slate. As the statistics collected by the Geological Survey are obtained from the quarrymen rather than from the dealers and jobbers the figures obtained for the distribution of the sales of slate in 1923 were not very satisfactory, although some of the largest dealers cooperated with the Survey by furnishing statements of the distribution of their sales for the year. Among the large jobbers of slate are the Vendor Slate Co., Easton, Pa., selling the roofing slate of many quarrymen in Pennsylvania and Vermont; the Natural Slate Blackboard Co., Pen Argyl, Pa., distributors of slate blackboards; the American Slate Works and the National School Slate Co., Slatington, Pa., distributors of school slates; and the Structural Slate Co., Pen Argyl, Pa., distributors of structural and sanitary slate, electrical slate, and slate for billiard-table tops. These companies act chiefly for the Pennsylvania quarries. In New York and Vermont the larger producing companies and other jobbers and dealers act as distributing agents.

The table below shows the shipments in 1923 by States of such products, as were reported. They range from three-fourths to practically all of the total sales reported. The States are grouped to follow as closely as possible the territories covered by the different freight associations.

Distribution of slate products reported to the Geological Survey in 1923, grouped by general freight districts

Destination	Structural and sanitary (square feet)	Electrical (square feet)	Vaults and covers (square feet)	Black-boards and bulletin boards (square feet)	Billard table tops (square feet)	Granules (tons)
New England States: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island	344,450	151,947	92,943	265,603	780	29,468
Middle Atlantic States: New York, New Jersey, Pennsylvania, Delaware, Maryland, District of Columbia, Virginia, and West Virginia	972,439	815,126	394,948	1,178,509	268,594	151,618
South Atlantic States: North Carolina, South Carolina, Georgia, and Florida	19,902	4,927	1,710	178,371	----------	--------
Northeastern Central States: Ohio, Indiana, Illinois, and Michigan	184,088	305,024	17,287	903,804	80,332	201,062
Southeastern Central States: Kentucky, Tennessee, Mississippi, and Alabama	10,488	8,311	172	114,198	----------	1,174
Northwestern Central States: Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska, Iowa, Kansas, Missouri, and Colorado	47,741	115,120	55,166	650,220	15,268	1,982
Southwestern Central States: Oklahoma, Arkansas, Texas, and Louisiana	3,278	128	----------	145,366	----------	16,676
Northern Mountain States: Montana, Idaho, and Wyoming	----------	1,000	----------	6,914	----------	--------
Southern Mountain States: Utah, Nevada, Arizona, and New Mexico	----------	----------	----------	17,400	----------	442
Pacific Coast States: Washington, Oregon, and California	13,838	956	----------	353,682	----------	3,394
	1,596,224	1,402,539	562,226	3,814,067	364,974	405,816
Exports	(a)	[a] 209,594	----------	91,267	50,429	5,109
Total distribution reported	[a]1,596,224	[a]1,612,133	562,226	3,905,334	415,403	410,925
Total sales	2,182,620	2,182,890	451,160	4,415,710	527,680	462,260

[a] Small amount of structural slate included with electrical.

So far as these figures show, structural slate, although shipped throughout the United States, finds its largest market at present in the New England and Middle Atlantic States, which are nearest to the source of the material, and the northeastern and northwestern Central States, which include the markets of Chicago, Cleveland, Cincinnati, Denver, St. Paul, Minneapolis, St. Louis, and other cities of considerable size. The largest markets for electrical slate are in the same groups of States as those for structural slate, the consumption being chiefly concentrated in the industrial centers of Schenectady, Pittsburgh, Boston, Newark, Philadelphia, Chicago, Cleveland, and other cities of the Middle West. Slate for blackboard and bulletin boards is shipped throughout the United States, but slate for school slates is mostly shipped abroad. (See p. 57.) Slate for billiard-table tops finds its chief market in the Middle Atlantic and northeastern Central States. Sales of slate for grave vaults and covers are apparently confined at present chiefly to the Middle Atlantic, New England, and northwestern Central States. In the northeastern Central States, where other slate products have found considerable market, sandstone quarried in Ohio is largely used for vaults and covers. As shown in the foregoing table the reported shipments in 1923 of slate for this purpose were larger than the production given in the table on page 55. This difference may be due to increased sales from stock or to the classification of slate by quarrymen as "structural and sanitary," although it may have been afterwards sold by the dealers for vaults and covers.

It is to be regretted that adequate figures showing the shipments of roofing-slate shingles by States were not obtained. The distributors of this slate product were not willing to furnish figures of their shipments by States. The figures for shipments that were received, however, showed a wide range of markets. Shipments of less than 30 per cent of the output showed that slate shingles were shipped to more than half of the United States. California, Washington, Utah, Montana, Louisiana, Florida, and Georgia received small portions of the output. The greater part, however, was distributed east of the Mississippi and, with the exception of Louisiana, north of South Carolina and of Ohio River. Slate granules and flour were shipped mostly to plants manufacturing prepared roofing, near Boston, New York, Philadelphia, Cincinnati, Chicago, and New Orleans. It is possible that some of the slate noted as shipped to the different States may not have been consumed in those States but may have been reshipped by dealers or distributors.

GYPSUM

By K. W. Cottrell

PRODUCTION

In 1923 for the first time the quantity of gypsum mined in the United States exceeded 4,000,000 short tons. The output showed an increase of 26 per cent over that of 1922.

Of the total quantity of crude gypsum sold only 3 per cent was sold for use in agriculture, a decrease of 75 per cent from the sales of 1922. Kansas, Montana, and Oregon, however, showed slight increases. Sales of agricultural gypsum decreased over 90 per cent in each of eight States, more than 50 per cent in each of three others, but less than 20 per cent each in California and Virginia.

The total quantity of gypsum sold crude to Portland cement factories in 1923 was 15 per cent greater than in 1922. New York was the only State which reported a decrease (15 per cent) in such sales; increases in other important producing States ranged from 10 per cent in Oklahoma to 67 per cent in Iowa.

Sales of Keenes cement increased 6 per cent over those of 1922, but the receipts from sales decreased. The average value per ton dropped from $14.75 to $13.88.

Plaster board, tile, and blocks were made in 14 States at plants operated by the original producers of the gypsum used in their manufacture. Plants of firms that make these products but do not mine gypsum are not included here, the gypsum they use being already accounted for as plaster sold by the original manufacturers. The figures given for boards and blocks therefore do not include the entire production of these articles in the United States. Wall board increased 64 per cent in quantity and 58 per cent in value, but the average value per ton decreased from $37.32 to $36.16. Blocks and tile increased 23 per cent in quantity and 30 per cent in value, and the average value per ton increased from $12.20 to $13.07.

Gypsum produced and sold in the United States, 1918–1923

Year	Crude produced (short tons)	Value of crude and calcined sold
1918	2,057,015	$11,470,854
1919	2,420,163	15,727,907
1920	3,129,142	24,533,065
1921	2,890,784	23,700,290
1922	3,779,949	29,361,151
1923	4,753,448	34,888,155

Gypsum produced and sold in the United States, 1922 and 1923, by States

State	Number of active plants reporting	Total quantity produced (short tons)	Sold without calcining				Sold calcined		Total value
			Agricultural gypsum		For Portland cement, paint, and other purposes				
			Short tons	Value	Short tons	Value	Short tons	Value	
1922									
Arizona	1	9,319					7,832	$64,625	$64,625
Arkansas	1	600			600	$1,800			1,800
Iowa	6	536,905	45,062	$136,451	80,452	223,187	326,937	3,786,544	4,146,182
Kansas	3	105,481	(a)	(a)	33,019	86,612	57,998	604,093	690,740
Michigan	6	471,355	13,054	40,583	94,654	250,712	275,885	2,551,822	2,843,117
Nevada	5	276,859	(a)	(a)	19,021	57,187	200,454	1,971,709	2,043,974
New York	8	1,055,302	13,708	49,537	267,822	801,848	631,735	7,955,981	8,807,366
Ohio	3	435,485	3,659	17,142	6,020	20,189	347,697	3,938,769	3,976,100
Oklahoma	5	242,932	(a)	(a)	42,279	118,997	150,627	1,532,825	1,651,837
Texas	5	221,914	(a)	(a)	(a)	(a)	242,268	2,030,688	2,081,479
Utah	3	48,338	(a)	(a)	(a)	(a)	38,684	290,546	304,562
Wyoming	5	47,222			(a)	(a)	31,386	260,819	269,574
Other States[b]	13	328,237	[c] 26,421	[c] 143,490	[c] 124,954	[c] 495,611	179,762	1,929,384	2,479,795
	64	3,779,949	101,904	387,203	668,821	2,056,143	2,491,265	26,917,805	29,361,151
1923									
California	3	111,832	2,865	21,796	(a)	(a)	24,936	374,040	670,495
Iowa	7	685,041	329	1,961	134,566	383,322	431,829	4,983,249	5,368,532
Kansas	3	135,019	(a)	(a)	54,021	141,961	71,349	700,490	842,740
Michigan	6	586,987	616	3,465	135,000	351,602	341,746	2,897,926	3,252,993
Nevada	4	298,390	(a)	(a)	(a)	(a)	226,753	1,891,639	1,952,007
New York	8	1,361,116	1,249	5,906	228,831	712,093	823,241	9,626,746	10,344,745
Ohio	3	526,861	(a)	(a)	17,563	55,014	432,511	4,919,375	4,981,542
Oklahoma	4	290,121			47,041	125,182	202,323	2,123,713	2,248,895
Texas	4	344,104			(a)	(a)	254,512	2,177,983	2,237,024
Utah	3	44,531	(a)	(a)	(a)	(a)	33,520	269,148	286,957
Wyoming	4	33,644					27,945	176,791	176,791
Other States[b]	13	335,802	[c] 20,367	[c] 116,898	[c] 204,794	[c] 658,236	230,713	2,169,619	2,525,434
	62	4,753,448	25,426	150,026	821,816	2,427,410	3,101,378	32,310,719	34,888,155

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[a] Included under "Other States."

[b] 1922: Alaska, California, Colorado, Montana, New Mexico, Oregon, South Dakota, and Virginia; 1923: Arizona, Colorado, Montana, New Mexico, Oregon, South Dakota, and Virginia.

[c] This figure includes also output of States entered as "(a)" above.

Gypsum, produced in the United States, sold in 1923, by uses

	Short tons	Value
Calcined:		
Stucco	455,161	$3,106,333
Neat plaster	1,536,077	13,061,700
Sanded plaster	178,016	1,191,473
Mixed plaster	[a] 268,271	[a] 2,373,276
Plaster of Paris, molding, casting plaster, etc.	[b] 155,295	[b] 1,585,585
Keenes cement	23,273	323,127
To plate-glass works	21,435	163,358
Plaster board	68,431	727,562
Wall board	197,218	7,131,668
Partition tile	134,437	1,537,783
Special tile or blocks	22,456	293,512
Other purposes [c]	41,308	815,342
	3,101,378	32,310,719
Crude	847,242	2,577,436
	-------------	34,888,155

[a] Includes small quantity of wood fiber plaster.
[b] Includes dental plaster.
[c] Includes roof tile and miscellaneous material.

Keenes cement, produced in the United States, sold in 1918–1923

Year	Manufacturers	Short tons	Value
1918	5	12,823	$151,802
1919	6	15,395	200,360
1920	6	16,542	246,433
1921	7	14,430	232,457
1922	6	21,991	324,316
1923	5	23,273	323,127

IMPORTS AND EXPORTS[1]

Six companies in the gypsum industry reported to the Geological Survey that they imported gypsum in 1923. These were the Connecticut Adamant Plaster Co., Higginson Manufacturing Co., Newark Plaster Co., Rock Plaster Corporation, Charles W. Priddy & Co., and United States Gypsum Co. The quantity of gypsum reported by these six companies as imported was more than that reported by the Bureau of Foreign and Domestic Commerce. Of the gypsum imported, over 27,000 tons was sold crude. Of this quantity 86 per cent was sold for use in agriculture and the remainder to paint mills and for other purposes. More than 350,000 tons was sold calcined and was used principally in the manufacture of gypsum plasters. It is estimated that the value of the imported gypsum and products manufactured from it sold by these six firms in 1923 was more than $5,000,000, in comparison with a business of nearly $35,000,000 done by the entire domestic industry.

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[1] The data relating to imports and exports were compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

As a large part of the Canadian output is imported into the United States and is a chief source of supply for the eastern seaboard States, the following table is of interest:

Gypsum produced and sold in Canada, 1918–1923 [a]

Year	Short tons	Value
1918	152, 287	$823, 006
1919	299, 063	1, 215, 287
1920	429, 144	1, 893, 991
1921	386, 550	1, 785, 538
1922	559, 265	2, 160, 898
1923	559, 778	2, 165, 953

[a] 1918–1920: Report on mineral production of Canada, Canada Dept. Mines; 1921–1923: Dominion Bur. Statistics Ann. Rept. for 1921, and preliminary reports for 1922 and 1923.

Gypsum imported for consumption in the United States, 1918–1923

Year	Unground		Ground or calcined		Manufactured plaster of Paris	Keenes cement		Total value
	Short tons	Value	Short tons	Value		Short tons	Value	
1918	50, 653	$55, 004	6, 117	$70, 028	$1, 765	111	$2, 259	$129, 056
1919	171, 733	211, 946	10, 415	126, 405	7, 719	187	5, 984	352, 054
1920	282, 486	397, 942	14, 921	179, 191	10, 282	202	5, 338	592, 753
1921	266, 796	364, 318	4, 495	55, 109	33, 072	184	6, 836	459, 335
1922	409, 475	523, 939	1, 774	32, 651	55, 116	403	9, 636	621, 342
1923	448, 129	629, 203	5, 133	77, 716	41, 317	418	11, 543	759, 779

Gypsum, crude, imported into the United States in 1923, by countries

[General imports]

Country	Short tons	Value
Canada	446, 790	$620, 211
England	1, 193	3, 929
France	103	4, 487
Germany	35	418
Hongkong	8	158
	448, 129	629, 203

Exports of gypsum in 1923 were 8,815 short tons, valued at $226,423, compared with 7,673 tons, valued at $178,166, in 1922. Exports are designated as "gypsum or plaster, crude, ground, calcined, and manufactures of." Exports not separately classified for earlier years.

MANUFACTURERS

MANUFACTURERS OF GYPSUM PLASTER

HEAD OFFICES

Alabastine Co., Grand Rapids, Mich.
American Gypsum Co., Buffalo, N. Y.
American Gypsum Co., Port Clinton, Ohio.
Arizona Gypsum Plaster Co., Douglas, Ariz.

Beaver Products Co. (Inc.), Buffalo, N. Y.
Best Bros. Keenes Cement Co., Medicine Lodge, Kans.
Cardiff Gypsum Plaster Co., Fort Dodge, Iowa.
Centerville Gypsum Co., Centerville, Iowa.
Certain-teed Products Corporation, 100 East 42d Street, New York, N. Y.
Colorado Portland Cement Co., Ideal Building, Denver, Colo.
Connecticut Adamant Plaster Co. (importer), New Haven, Conn.
Dakota Plaster Co., Rapid City, S. Dak.
Ebsary Gypsum Co. (Inc.), Scottsville, N. Y.
Empire Gypsum Co., Rochester, N. Y.
Garbutt & Orcutt, 712 Pantages Building, Los Angeles, Calif.
Globe Plaster & Mining Co., 222 Commerce Building, Kansas City, Mo.
Grand Rapids Plaster Co., Grand Rapids, Mich.
Higginson Manufacturing Co. (importer), Newburgh, N. Y.
Jumbo Plaster & Cement Co., Sigurd, Utah.
Laramie Cement Plaster Co., Laramie, Wyo.
Lycoming Calcining Co., Williamsport, Pa.
Michigan Gypsum Co., Grand Rapids, Mich.
Nephi Plaster & Manufacturing Co., 322 Van Ness Building, Salt Lake City, Utah.
Newark Plaster Co. (importer), Newark, N. J.
Niagara Gypsum Co., Buffalo, N. Y.
Northwest Gypsum Products Co., Lewistown, Mont.
Oakfield Gypsum Products Corporation, Oakfield, N. Y.
Oklahoma Portland Cement Co., Denver, Colo.
Overland Cement Plaster Co., Laramie, Wyo.
Pacific Coast Gypsum Co., Tacoma, Wash.
Pacific Portland Cement Co., Pacific Building, San Francisco, Calif.
Rock Plaster Corporation (importer), 40 Rector Street, New York, N. Y.
Southern Gypsum Co., North Holston, Va.
Standard Gypsum Co. (Inc.), San Francisco, Calif.
Texas Cement Plaster Co., Oklahoma City, Okla.
Three Forks Portland Cement Co., Denver, Colo.
United States Gypsum Co., 205 West Monroe Street, Chicago, Ill.
Universal Gypsum Co., Chicago, Ill.
Wasem Plaster Co., Fort Dodge, Iowa.
White Star Plaster Co., 1324 Washington Building, Los Angeles, Calif.
Wyoming Cement Plaster Co., Greybull, Wyo.

MANUFACTURERS OF GYPSUM PLASTER OPERATING MORE THAN ONE PLANT

Beaver Products Co. (Inc.)	Fort Dodge, Iowa.
	Blue Rapids, Kans.
	Grand Rapids, Mich.
	Akron, N. Y.
	Gypsum, Ohio.
	Acme, Tex.
Certain-teed Products Corporation	Grand Rapids, Mich.
	Acme, N. Mex.
	Acme, Okla.
	Gypsum, Oreg.
	Acme, Tex.
	Laramie, Wyo.
Colorado Portland Cement Co	Coaldale, Colo.
	Hanover, Mont.
	Red Butte, Wyo.
Grand Rapids Plaster Co	Grand Rapids, Mich.
	Grandville, Mich.
United States Gypsum Co	Amboy, Calif.
	Loveland, Colo.
	Fort Dodge, Iowa.
	Blue Rapids, Kans.
	Alabaster, Mich.
	Grand Rapids, Mich.
	Arden, Nev.
	Oakfield, N. Y.

United States Gypsum Co	Gypsum, Ohio. Eldorado, Okla. Southard, Okla. Piedmont, S. Dak. Plasterco, Va.
Universal Gypsum Co	Fort Dodge, Iowa.

MANUFACTURERS OF KEENES CEMENT

American Cement & Plaster Co., Salt Lake City, Utah.
Best Bros. Keenes Cement Co., Medicine Lodge, Kans.
Certain-teed Products Corporation, 100 East 42d Street, New York, N. Y.
Nephi Plaster & Manufacturing Co., 322 Ness Building, Salt Lake City, Utah.
Pacific Portland Cement Co., Pacific Building, San Francisco, Calif.
Texas Cement Plaster Co., Oklahoma City, Okla.
United States Gypsum Co., 205 West Monroe Street, Chicago, Ill.
Wasem Plaster Co., Fort Dodge, Iowa.

MANUFACTURERS OF GYPSUM PLASTER BOARD AND WALL BOARD

American Gypsum Co., Port Clinton, Ohio.
Beaver Products Co. (Inc.), Buffalo, N. Y.
Bell, H. W., & Co., 2592 Park Avenue, New York, City.
Buttonlath Manufacturing Co., Vernon and Boyle avenues, Los Angeles, Calif.
Duffy, J. P., & Co., 51st Street and Second Avenue, Brooklyn, N. Y.
Empire Gypsum Co., Rochester, N. Y.
Gypsite Fireproofing Co., 2034 Dime Bank Building, Detroit, Mich.
Hercules Plaster Board Co., Hampton, Va.
Kelley Plaster & Plaster Board Co., 261 Central Avenue, Passaic, N. J.
Key Hold Lath Co., 148 Hooper Street, San Francisco, Calif.
New Jersey Adamant Manufacturing Co., 79 Passaic Avenue, East Newark, N. J.
Pacific Coast Gypsum Co., Tacoma, Wash.
Rader, Gustav, 1105 Metropolitan Avenue, Brooklyn, N. Y.
Reeb, M. A., Corporation, 597 Michigan Avenue, Buffalo, N. Y.
Rock Plaster Corporation (importer), 40 Rector Street, New York City.
Schumacher Wall Board Co., 58th Street and San Pedro and Slauson avenues, Los Angeles, Calif.
Southern Gypsum Co., North Holston, Va.
United States Gypsum Co., 205 West Monroe Street, Chicago, Ill.
Universal Gypsum Co., Chicago, Ill.

MANUFACTURERS OF GYPSUM BLOCK AND TILE

Alabastine Co., Grand Rapids, Mich.
American Gypsum Co., Port Clinton, Ohio.
Arizona Gypsum Plaster Co., Douglas, Ariz.
Beaver Products Co. (Inc.), Buffalo, N. Y.
Certain-teed Products Corporation, 100 East 42d Street, New York, N. Y.
Ebsary Gypsum Co. (Inc.), Scottsville, N. Y.
Empire Gypsum Co., Rochester, N. Y.
Nephi Plaster & Manufacturing Co., 322 Ness Building, Salt Lake City, Utah.
Plymouth Gypsum Co., Fort Dodge, Iowa.
Reeb, M. A., Corporation, 597 Michigan Avenue, Buffalo, N. Y.
United States Gypsum Co., 205 West Monroe Street, Chicago, Ill.
Wyoming Cement Plaster Co., Greybull, Wyo.

MINERS

[Gypsum sold crude only]

Briggs, K. S., El Paso, Tex.
Phoenix Gypsum Co. (Inc.), 621 Mutual Life Building, Buffalo, N. Y.
Simmons, Arthur, Norwich, N. Y.

PEAT

By K. W. Cottrell

Returns made by the operators to the Geological Survey for 1923 indicated little change in the peat industry of the United States. Several companies dropped out of business, but new ones entered. The number of operators reporting for 1923 was 22, one less than for 1922.

The quantity of peat produced in the United States in 1923 was 61,355 short tons, valued at $376,834. This exceeded by 1 per cent the quantity produced in 1922; the value decreased 5 per cent. The quantity of peat sold for use as a fertilizer or as an ingredient of fertilizer increased less than 1 per cent over that sold in 1922, and the value decreased 5 per cent. The quantity of peat used as fuel in 1923 was negligible.

The 22 plants reporting the production of peat in 1923 were distributed as follows: California, New Jersey, and New York, 4 each; Illinois, Maine, and Michigan, 2 each; Florida, Indiana, Massachusetts, and Pennsylvania, 1 each. Illinois was the largest producer, but the State total may not be published, as only two operators reported. New Jersey ranked second, with an output of 18,380 short tons, valued at $107,885. California ranked third, with an output of 8,133 short tons, valued at $73,799.

Peat produced in the United States, 1919–1923, by uses

Year	Fertilizer and fertilizer ingredient		Stock food		Fuel		Other products [a]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1919	54,690	$557,240	6,402	$98,940	(b)	(b)	8,105	$49,352	69,197	$705,532
1920	63,272	773,635	[c] 9,182	[c] 143,047	750	$5,050	(c)	(c)	73,204	921,732
1921	29,460	251,046	[d] 946	[d] 9,073	(d)	(d)	(d)	(d)	30,406	260,119
1922	57,747	369,165	[c] 1,893	[c] 20,864	1,040	7,700	(c)	(c)	60,680	397,729
1923	57,907	351,641	[d] 3,448	[d] 25,193	(d)	(d)	(d)	(d)	61,355	376,834

[a] Peat moss, stable litter, and packing material. Also peat for fuel in 1919.
[b] Included under "Other products."
[c] Small quantity of miscellaneous products included under "Stock food."
[d] Small quantity of peat for fuel and miscellaneous products included under "Stock food."

Peat moss imported for consumption in the United States, 1918–1923 [a]

Year	Short tons	Value	Year	Short tons	Value
1918			1921	3,450	$22,754
1919	464	$16,345	1922	4,805	33,034
1920	2,762	36,201	1923	5,973	43,184

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[a] Statistics of imports compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

The following individuals and companies reported to the Geological Survey that they produced peat in the United States in 1923:

Blaine, J. H., Hopewell Junction, N. Y.
Central Peat Corporation, Capac, Mich.
Chapman, I. S. & Co. (Inc.), 101 South E Street, San Bernardino, Calif.
Craig, William N., Fishkill, N. Y.
Dow, Fred T., Bangor, Maine.
First Massachusetts Carbon Fuel Co., 306 Main Street, Worcester, Mass.
Florida Humus Co., Zellwood, Fla.
Humus Natural Manure Co., 1964 Broadway, New York, N. Y.
Hyper-Humus Co., Newton, N. J.
Keystone Humus Co., Hartstown, Pa.
Loskamp, P., Stockton, Calif.
McElhone, Asa, Fishkill, N. Y.
Manito Chemical Co., Peoria, Ill.
Marcrum, J. G., Netcong, N. J.
Moss Products Co., Jackman, Maine.
National Humus & Chemical Co., Chassell, Mich.
Pacific Humus Co., 802 Knickerbocker Building, Los Angeles, Calif.
Riverside Orange Co. (Ltd.), Arlington Heights, Riverside, Calif.
Sims, Alfred F., Sag Harbor, N. Y.
Standard Agricultural Chemical Corporation, 2 Rector Street, New York, N. Y.
Steenburg, W. C., South Bend, Ind.
Wiedmer Chemical Co., Pierce Building, St. Louis, Mo.

CLAY

By Jefferson Middleton

GENERAL CONDITIONS

Clay available for the manufacture of clay products is widely distributed in the United States, and there are clay-working plants in every State in the Union. The following tables represent chiefly clay that is mined and sold as clay. The quantity thus sold is small compared with the total output and includes mainly clay used for making high-grade pottery and tile and refractory products. The values given for domestic production are f. o. b. at the mines; for imports, at the principal markets of the countries from which the clay is exported; for exports, at the ports of shipment.

The general prosperity of 1923 was shared by the clay-mining industry, which made the largest sales of clay yet recorded. The output in 1923 was greater by 320,816 tons, or 10 per cent, than that in 1917, the year of largest output prior to 1923. The value of the clay sold in 1923, however, was less by $87,750, or 0.8 per cent, than that in 1920, the year of greatest value. The increase in quantity over the output of 1922 was 786,960 tons, or 30 per cent, and the increase in value was $2,858,399, or 34 per cent. Every kind of clay named in this report except stoneware clay increased in quantity, and every kind increased in value. The decrease in stoneware clay compared with 1922 was small—5,477 tons, or 6 per cent. Ohio, the largest producer of stoneware clay in 1922, showed the greatest decrease, owing to a strike in the great stoneware-pottery region of that State, in Muskingum and Perry counties. Slip clay showed the largest proportional increases—110 per cent in quantity and 125 per cent in value. Fire clay, which constitutes the largest volume of clay sold, forming 67 per cent of the total in 1923, showed the largest increases—618,943 tons, or 37 per cent, and $1,932,413, or 42 per cent. The increasing use of domestic kaolin and the fact that imports of foreign kaolin are increasing but little should be most gratifying to the miners and users of this material, as they lead to the hope that eventually this country will become independent of foreign supplies of kaolin. Ball clay, which is largely used in combination with kaolin in the manufacture of high-grade ceramic wares, increased considerably in quantity and value. It reached its highest value in 1923—$620,978, which was 41 per cent greater than in 1922 and 5 per cent greater than in 1918, the year of greatest value prior to 1923. The quantity of ball clay in 1923 was 10,338 tons, or 10 per cent less than in 1917, the year of largest production, but 20,276 tons, or 26 per cent, more than in 1922. This is another kind of clay for which the country has been largely dependent on foreign supplies, but a study of the comparative value of the American and English ball clays by the Bureau of Standards[1] shows that in some respects the American clays are superior and in others equal to the English clays and only require more careful manipulation to make them acceptable substitutes.

Imports of clay in 1923 increased 30,703 short tons, or 9 per cent, in quantity, and $266,348, or 8 per cent, in value, compared with 1922. Imports of every kind of clay reported increased in quantity and value except wrought clay, usually the smallest item among imported clays. The unwrought clays, which probably include ball clay, showed the largest increase—24,755 tons, or 61 per cent, in quantity, and $154,226, or 47 per cent, in value. Exports of clay increased in even greater proportion than production. The quantity of clay exported increased 37,219 tons, or 78 per cent, and the value increased $195,295, or 45 per cent, compared with 1922. Fire clay, which constituted 59 per cent of the quantity and 48 per cent of the value of clay exported in 1923, increased 25,664 tons, or 105 per cent, and $134,011, or 79 per cent, compared with 1922. Notwithstanding the large increases in exports, compared with 1922, the quantity was 29 per cent and the value 46 per cent less than in 1920, the year of maximum quantity and value.

PRODUCTION

Domestic clay sold in the United States, 1914–1923, by kinds

Year	Kaolin, china clay, and paper clay		Ball clay		Slip clay		Fire clay	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1914	150, 519	$843, 151	67, 927	$255, 767	8, 237	$17, 731	1, 409, 467	$2, 147, 277
1915	141, 064	781, 142	75, 348	301, 910	7, 646	18, 774	1, 570, 481	2, 361, 482
1916	201, 157	1, 075, 730	89, 761	391, 152	14, 064	47, 939	2, 057, 814	3, 708, 009
1917	206, 334	1, 263, 799	107, 406	569, 240	16, 972	70, 505	2, 347, 972	5, 625, 095
1918	179, 694	1, 459, 529	89, 896	590, 631	13, 552	49, 898	2, 305, 033	5, 664, 064
1919	152, 828	1, 475, 681	65, 026	520, 849	5, 149	17, 556	1, 755, 331	4, 628, 605
1920	268, 203	2, 865, 407	69, 477	584, 611	9, 006	41, 519	2, 261, 915	7, 088, 049
1921	162. 726	1, 579, 163	54, 014	354, 565	4, 608	14, 841	1, 195, 861	3, 560, 373
1922	275, 675	2, 346, 095	76, 792	440, 877	4, 050	19, 405	1, 679, 220	4, 633, 486
1923	336, 803	2, 926, 255	97, 068	620, 978	8, 520	43, 609	2, 298, 163	6, 565, 899

Year	Stoneware clay		Brick clay		Miscellaneous clay		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1914	130, 383	$116, 610	199, 154	$161, 852	244, 173	$214, 180	2, 209, 860	$3, 756, 568
1915	134, 297	126, 429	101, 968	93, 863	332, 150	288, 341	2, 362, 954	3, 971, 941
1916	135, 958	137, 779	97, 164	76, 854	336, 672	314, 311	2, 932, 590	5, 751, 774
1917	81, 352	113, 839	93, 779	94, 703	260, 029	305, 365	3, 113, 844	8, 042, 546
1918	86, 800	147, 098	(a)	(a)	301, 386	421, 421	2, 976, 361	8, 332, 641
1919	60, 236	80, 367	(a)	(a)	236, 530	367, 573	2, 275, 100	7, 090, 631
1920	106. 350	229, 221	(a)	(a)	322, 100	467, 856	3, 037, 051	11, 276, 663
1921	86, 574	184, 540	(a)	(a)	242, 963	361, 818	1, 746, 746	6, 055, 300
1922	86, 866	164, 870	(a)	(a)	525, 097	725, 781	2, 647, 700	8, 330, 514
1923	81, 389	194, 358	(a)	(a)	612, 717	837, 814	3, 434, 660	11, 188, 913

[a] Included under "Miscellaneous clay."

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[1] Sortwell, H. H., American and English ball clays: Bur. Standards Tech. Paper 227, pp. 153–182, 1923.

Domestic clay sold in the United States in 1922, by States and kinds

State	Number of active operators reporting	Kaolin, china clay, and paper clay		Ball clay		Fire clay	
		Short tons	Value	Short tons	Value	Short tons	Value
Alabama	8	220	$660			55, 483	$44, 355
Arkansas	([a])					176	1, 848
California	20	2, 683	38, 280	6, 726	$22, 944	134, 194	232, 689
Colorado	19					44, 293	65, 007
Connecticut	([a])						
Delaware	3	1, 076	14, 000			([a])	([a])
Florida	([a])	([a])	([a])				
Georgia	14	100, 668	709, 745			2, 235	8, 550
Idaho	([a])					394	2, 410
Illinois	17			3, 184	8, 945	96, 417	183, 786
Indiana	13					40, 324	61, 967
Iowa	5						
Kentucky	17			26, 148	128, 028	41, 437	142, 680
Maryland	16	5, 300	7, 400			11, 099	55, 144
Massachusetts	4					953	3, 704
Michigan	4						
Minnesota	([a])						
Mississippi	([a])					1, 080	2, 160
Missouri	34	1, 013	9, 810			[b] 409, 865	[b] 1, 226, 953
Montana	([a])					3, 430	5, 416
Nebraska	([a])					248	890
Nevada	([a])	([a])	([a])				
New Jersey	42			9, 314	66, 555	244, 240	979, 345
New Mexico	5					1, 681	6, 542
New York	6					124	1, 240
North Carolina	5	14, 586	214, 552				
North Dakota	([a])	33	306			12	168
Ohio	57					183, 701	362, 049
Oregon	([a])						
Pennsylvania	75	44, 289	297, 197			290, 701	936, 134
South Carolina	9	53, 345	414, 855			([a])	([a])
South Dakota	([a])						
Tennessee	11			31, 420	214, 405	42, 245	146, 802
Texas	9					3, 504	22, 526
Utah	6					3, 039	17, 184
Vermont	([a])	([a])	([a])				
Virginia	3	([a])	([a])			663	2, 459
Washington	7					5, 681	12, 779
West Virginia	5					58, 692	94, 371
Wisconsin	([a])						
Wyoming	3						
Undistributed	21	52, 462	639, 290			3, 309	14, 328
	438	275, 675	2, 346, 095	76, 792	440, 877	[b] 1, 679, 220	[b] 4, 633, 486
Average value per ton			8. 51		5. 74		2. 76

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[a] Included under "Undistributed."

[b] These totals include 13,384 tons of diaspore clay from Missouri, valued at $109,229.

Domestic clay sold in the United States in 1922, by States and kinds—Continued

State	Stoneware clay		Miscellaneous clay [c]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			4, 820	$4, 750	60, 523	$49, 765
Arkansas					176	1, 848
California	9, 864	$16, 864	53, 273	85, 424	206, 740	396, 201
Colorado	1, 408	3, 520	102, 749	90, 094	148, 450	158, 621
Connecticut	(a)	(a)	(a)	(a)	(a)	(a)
Delaware					4, 203	26, 508
Florida					(a)	(a)
Georgia			130, 925	131, 777	233, 828	850, 072
Idaho					394	2, 410
Illinois	30, 154	49, 188	568	568	130, 323	242, 487
Indiana	(a)	(a)	5, 089	12, 173	45, 446	74, 288
Iowa			22, 887	23, 068	22, 887	23, 068
Kentucky			(a)	(a)	67, 591	270, 858
Maryland	(a)	(a)	55, 950	84, 425	72, 749	147, 969
Massachusetts			59	237	1, 012	3, 941
Michigan			1, 653	4, 852	1, 653	4, 852
Minnesota			19, 078	25, 287	19, 078	25, 287
Mississippi					1, 080	2, 160
Missouri	1, 250	1, 859			412, 128	1, 238, 622
Montana			3, 933	6, 000	7, 363	11, 416
Nebraska					248	890
Nevada			(a)	(a)	(a)	(a)
New Jersey	10, 008	41, 256	49, 798	119, 791	313, 360	1, 206, 947
New Mexico					1, 681	6, 542
New York			5, 852	19, 223	5, 976	20, 463
North Carolina	10	10	60	60	14, 656	214, 622
North Dakota					45	474
Ohio	31, 265	46, 076	20, 718	40, 552	235, 684	448, 677
Oregon	399	1, 496	2, 889	8, 031	3, 288	9, 527
Pennsylvania	1, 868	2, 906	44, 401	70, 016	381, 259	1, 306, 253
South Carolina			50	50	53, 577	416, 725
South Dakota			100	1, 000	100	1, 000
Tennessee	20	110	429	964	74, 114	362, 281
Texas	50	75			3, 554	22, 601
Utah			1, 528	3, 570	4, 567	20, 754
Vermont					(a)	(a)
Virginia			(a)	(a)	13, 810	113, 828
Washington			455	1, 966	6, 136	14, 745
West Virginia					58, 692	94, 371
Wisconsin			230	748	230	748
Wyoming			466	7, 313	466	7, 313
Undistributed	570	1, 510	1, 187	3, 247	40, 633	531, 380
	86, 866	164, 870	[d] 529, 147	[d] 745, 186	2, 647, 700	8, 330, 514
Average value per ton		1. 90				3. 15

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[a] Included under "Undistributed."

[c] Includes ardmorite, bentonite, shale, clay for art pottery, asbestos products, blast furnaces, brick, cement, decolorizing oils, drain tile, fireworks, foundries, high-grade tile, hollow ware, modeling, paint, plaster and its products, red earthenware, roofing tile, sewer pipe, stove polish, and terra cotta. Slip clay is also included in this column as a matter of statistical convenience.

[d] These totals include 4,050 tons of slip clay, valued at $19,405, or $4.79 a ton, from Michigan (420 tons, valued at $2,162) and New York (3,630 tons, valued at $17,243).

Domestic clay sold in the United States in 1923, by States and kinds

State	Number of active operators reporting	Kaolin, china clay, and paper clay		Ball clay		Fire clay	
		Short tons	Value	Short tons	Value	Short tons	Value
Alabama	10					77,440	$108,478
Arizona	([a])						
Arkansas	([a])					167	1,754
California	23	2,049	$17,237	1,794	$7,070	143,089	239,013
Colorado	17					146,000	217,258
Connecticut	([a])						
Delaware	([a])	1,282	17,400			4,000	12,000
Florida	([a])	([a])	([a])				
Georgia	15	123,994	867,808			4,066	18,427
Idaho	([a])					133	1,297
Illinois	20			3,625	16,063	130,340	245,873
Indiana	14	147	1,764			56,718	90,625
Iowa	5						
Kentucky	19			31,141	177,579	70,993	250,320
Maryland	18	([a])	([a])			22,152	99,144
Massachusetts	5					406	2,131
Michigan	4						
Minnesota	([a])						
Mississippi	3					1,059	9,380
Missouri	32	([a])	([a])			[b]491,211	[b]1,607,927
Montana	4					11,624	20,033
Nebraska	([a])					255	965
Nevada	([a])	1,000	10,000				
New Jersey	41			11,280	89,838	286,145	1,353,566
New Mexico	5					3,135	11,939
New York	6					247	3,211
North Carolina	6	23,673	369,398				
North Dakota	([a])	8	58			21	326
Ohio	61					292,216	681,508
Oregon	([a])						
Pennsylvania	72	60,669	378,712			412,744	1,172,333
South Carolina	7	54,748	451,412			300	3,000
South Dakota	([a])						
Tennessee	11			49,228	330,428	55,464	197,661
Texas	10					3,623	23,391
Utah	5					1,740	12,700
Vermont	([a])	417	3,682				
Virginia	3	([a])	([a])			1,036	3,796
Washington	8	([a])	([a])			5,524	19,549
West Virginia	5					76,315	158,294
Wisconsin	([a])						
Wyoming	3						
Undistributed	22	68,816	808,784				
	454	336,803	2,926,255	97,068	620,978	[b]2,298,163	[b]6,565,899
Average value per ton			8.69		6.40		2.86

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[a] Included under "Undistributed."

[b] These totals include 10,617 tons of diaspore clay from Missouri, valued at $54,450.

Domestic clay sold in the United States in 1923, by States and kinds—Continued

State	Stoneware clay		Miscellaneous clay [c]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			13,178	$9,941	90,618	$118,419
Arizona			30	360	30	360
Arkansas					167	1,754
California	5,096	$18,860	129,865	171,574	281,893	453,754
Colorado	(a)	(a)	(a)	(a)	190,250	272,276
Connecticut			703	1,139	703	1,139
Delaware					5,282	29,400
Florida					(a)	(a)
Georgia			190,961	190,961	319,021	1,077,196
Idaho					133	1,297
Illinois	29,997	49,750	1,933	2,233	165,895	313,919
Indiana			23,362	58,854	80,227	151,243
Iowa			4,666	4,730	4,666	4,730
Kentucky			61	122	102,195	428,021
Maryland	(a)	(a)	57,800	60,500	87,277	172,169
Massachusetts			952	4,725	1,358	6,856
Michigan			3,617	7,327	3,617	7,327
Minnesota			(a)	(a)	(a)	(a)
Mississippi	1,000	2,000			2,059	11,380
Missouri	(a)	(a)			495,797	1,624,789
Montana					11,624	20,033
Nebraska					255	965
Nevada			60	900	1,060	10,900
New Jersey	13,603	68,167	65,826	139,329	376,854	1,650,900
New Mexico					3,135	11,939
New York			8,000	40,490	8,247	43,701
North Carolina	(a)	(a)	(a)	(a)	23,793	369,518
North Dakota					29	384
Ohio	18,888	26,951	1,653	3,498	312,757	711,957
Oregon	271	1,037	830	1,796	1,101	2,833
Pennsylvania	7,373	17,571	36,606	58,266	517,392	1,626,882
South Carolina					55,048	454,412
South Dakota			400	4,000	400	4,000
Tennessee			649	1,462	105,341	529,551
Texas	79	147	121	335	3,823	23,873
Utah			2,510	2,600	4,250	15,300
Vermont					417	3,682
Virginia			(a)	(a)	14,303	128,071
Washington	(a)	(a)	4,817	8,916	10,491	29,040
West Virginia					76,315	158,294
Wisconsin			122	397	122	397
Wyoming			614	10,448	614	10,448
Undistributed	5,082	9,875	71,901	96,520	76,101	705,804
	81,389	194,358	[d] 621,237	[d] 881,423	3,434,660	11,188,913
Average value per ton		2.39				3.26

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[a] Included under "Undistributed."

[c] Includes ardmorite, bentonite, black-burning clay, montmorillonite, and shale; clay for architectural terra cotta, artificial abrasives, art pottery, asbestos products, blast furnaces, building brick, coke ovens, cosmetics, decolorizing oils, flower pots, foundries, gas retorts, greenhouse-glass coating, high-grade tile, hollow building tile, insecticides, medicines, modeling, paint, pencil leads, plaster and plaster products, roofing tile, sewer pipe, soap, and steel castings. Slip clay is also included in this column as a matter of statistical convenience.

[d] These totals include 8,520 tons of slip clay valued at $43,609, or $5.12 a ton, from Michigan (630 tons valued at $3,284) and New York (7,890 tons valued at $40,325).

Forty-two States reported clay sold as such in 1923, an increase of 1 (Arizona). The leading 10 States in the order of quantity sold were Pennsylvania (15 per cent of the total for the United States), Missouri (14 per cent), New Jersey (11 per cent), Georgia (9 per cent), Ohio (9 per cent), California (8 per cent), Colorado (6 per cent), Illinois (5 per cent), and Tennessee and Kentucky (3 per cent each). These ten States reported 83 per cent of the total output, and the first five reported 59 per cent. In all these States except Georgia fire clay is the leading kind reported, constituting from 51 per cent of the total output in California to 99 per cent in Missouri.

PRODUCTION BY USES

Statistics showing the production of clay by uses are necessarily incomplete, as many clay miners do not know the purpose to which their clay is put, but it is believed that the figures given in the following table are sufficiently complete to serve as a guide in the study of the uses of domestic clays. In considering these figures it should be borne in mind that they represent chiefly the clay sold as clay by the original producers and do not include the much greater quantities of clay that are burned into clay products by those who mine their own clay.

Domestic clay sold in the United States in 1923, by uses, in short tons

Use	Kaolin, china clay, and paper clay	Ball clay	Slip clay	Fire clay (including fire-clay dust)	Stoneware clay	Miscellaneous clay	Total
White-bodied ware made from white-burning clays, including china, general ware, chemical porcelain, porcelain electrical supplies, sanitary ware, etc	92, 761	36, 052		3, 791	50		132, 654
Art pottery	356	768		339	1, 100	550	3, 113
High-grade tile	24, 426	23, 894		8, 579	600	59	57, 558
Chemical stoneware				1, 906	5, 690		7, 596
Stoneware				8, 740	58, 212	1, 154	68, 106
Enameling, as coating for granite ware, etc	11	925	236	120			1, 292
Paper filler	102, 732			445			103, 177
Paper coating	9, 031						9, 031
Rubber	15, 279	100					15, 379
Oilcloth or linoleum	8, 165						8, 165
Paint filler or extender	13, 328	600		150		185	14, 263
Paint pigment						259	259
Architectural terra cotta		65		72, 691	10, 725	43, 163	126, 644
Asbestos products	308	820		1, 102		3, 774	6, 004
Plaster and plaster products	5, 582	208		16, 893		3, 378	26, 061
Slip for glazing purposes			3, 696				3, 696
Cement	(a)			(a)			41, 808
Kalsomine	2, 386						2, 386
Artificial abrasives		904	4, 588	5, 355	875	756	12, 478
Crayons (for tailors' use, etc.)	1, 009						1, 009
Chemicals	1, 325						1, 325
Pencil leads (graphite)		20				249	269
Saggers	5, 620	28, 522		160, 457	1, 952		196, 551
Pins, stilts, and spurs for potters' use	305	1, 726		7, 759			9, 790
Wads		1, 075		28, 289			29, 364
Gas retorts				15, 264	280	99	15, 643
Fire brick and block	5, 168			590, 282	25		595, 475
Fire-clay mortar, including clay processed for laying fire brick		681		442, 198			442, 879
Bauxite and high-alumina brick				2, 672			2, 672
Glasshouse pots	229	708		19, 642			20, 579
Glasshouse supplies, blocks, tiles, etc				39, 445			39, 445
Zinc retorts				28, 200			28, 200
Zinc condensers				13, 102			13, 102
Clay crucibles				4, 643			4, 643
Graphite crucibles and stoppers	26			2, 080			2, 106
Foundry use and steel works for cupola lining	51			515, 619		36, 863	552, 533
Unspecified [b]	48, 705			308, 400	1, 880	522, 228	839, 405
	336, 803	97, 068	8, 520	2, 298, 163	81, 389	612, 717	3, 434, 660

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[a] Included under "Unspecified."

[b] Includes clay for blast-furnace use, brick, cement, cosmetics, decolorizing oils, drain tile, electric appliances, hollow ware, insecticides, lead pots, matches, medicinal use, modeling, pottery, records (phonographic), roofing tile, sewer pipe, soap, wall paper, and water softener; also black-burning clay.

IMPORTS AND EXPORTS[2]

Clay imported for consumption in the United States, 1914–1923

Year	Kaolin or china clay			Common blue and Gross Almerode glass-pot clay		All other clays				Total	
		Value				Unwrought		Wrought			
	Short tons	Total	Average	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1914	328, 038	$1, 927, 425	$5. 88	16, 761	$122, 325	50, 069	$195, 956	3, 232	$41, 712	398, 100	$2, 287, 418
1915	209, 132	1, 152, 778	5. 51	8, 864	62, 569	23, 718	90, 367	1, 343	12, 433	243, 057	1, 318, 147
1916	253, 707	1, 326, 684	5. 23	2, 501	12, 134	42, 478	163, 421	180	1, 994	298, 866	1, 504, 233
1917	241, 029	1, 315, 769	5. 46	88	709	26, 581	123, 439	338	2, 142	268, 036	1, 442, 059
1918	168, 100	1, 153, 240	6. 86	114	983	26, 984	163, 484	137	1, 087	195, 335	1, 318, 794
1919	180, 592	1, 965, 393	10. 88	4	133	23, 759	187, 550	498	4, 262	204, 853	2, 157, 338
1920	361, 800	3, 568, 677	9. 86	6, 837	157, 201	34, 252	272, 524	691	10, 267	403, 580	4, 008, 669
1921	162, 906	1, 546, 285	9. 49	4, 468	77, 217	41, 421	348, 870	120	2, 313	208, 915	1, 974, 685
1922	310, 136	2, 963, 420	9. 56	7, 323	84, 415	40, 624	327, 388	2, 566	29, 398	360, 649	3, 404, 621
1923	311, 298	3, 046, 191	9. 79	12, 999	121, 272	65, 379	481, 614	1, 676	21, 892	391, 352	3, 670, 969

Domestic clay exported from the United States, 1916–1923

Year	Fire clay		All other		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1916	45, 752	$144, 552	27, 941	$145, 970	73, 693	$290, 522
1917	54, 023	268, 093	29, 194	178, 764	83, 217	446, 857
1918	60, 206	333, 880	24, 348	192, 053	84, 554	525, 933
1919	37, 486	262, 501	30, 983	249, 571	68, 469	512, 072
1920	54, 125	393, 177	66, 035	775, 222	120, 160	1, 168, 399
1921	23, 666	177, 979	23, 779	183, 449	47, 445	361, 428
1922	24, 391	169, 664	[a] 23, 285	[a] 267, 908	47, 676	437, 572
1923	50, 055	303, 675	34, 840	329, 192	84, 895	632, 867

[a] Includes 2,091 short tons of "kaolin, china clay, and paper clay" valued at $27,840. Similar exports are not separately classified for other years.

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[2] Figures of imports and exports compiled by J. A. Dorsey, of the U. S. Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

BARYTES AND BARIUM PRODUCTS[1]

By C. E. SIEBENTHAL and E. R. PHILLIPS

The value of the domestic crude barytes sold in 1923 was $1,664,156, as compared with $1,123,950 in 1922. The value of the barium products made from both domestic and foreign barytes was $13,735,184, as compared with $11,399,441 (revised figures) in 1922. The industry thus made a notable advance from the slump of 1921. The material sold, or shipped or used, is taken to represent the output.

CRUDE BARYTES

SALES

From 1901 to 1915 the output of domestic crude barytes ranged from 37,000 to 109,000 short tons, and the average was approximately 56,000 tons. The war cut off the foreign sources of supply and thus increased the demand for domestic ore, and the annual output from 1916 to 1920 averaged about 204,000 tons. The shipments of crude barytes from mines in 1923 were 38 per cent greater in quantity and 48 per cent greater in value than in 1922 and were exceeded in quantity only by the output of 1916 and of 1920.

Crude barytes shipped by domestic producers in the United States, 1901–1923

Year	Short tons	Value f. o. b. at mine		Year	Short tons	Value f. o. b. at mine	
		Total	Average			Total	Average
1901–1915 (average)	56,061	$180,669	$3.22	1922	155,040	$1,123,950	$7.25
1916–1920 (average)	204,330	1,419,521	6.95	1923	214,183	1,664,156	7.77
1921	66,369	531,958	8.02				

Crude barytes shipped by domestic producers in the United States, 1922–23, by States

State	1922				1923			
	Short tons	Percentage of total	Value f. o. b. at mine		Short tons	Percentage of total	Value f. o. b. at mine	
			Total	Average			Total	Average
California	3,338	2	$17,707	$5.30	(a)	(a)	(a)	(a)
Georgia	57,045	37	468,517	8.21	83,291	39	$670,343	$8.05
Missouri	66,421	43	421,568	6.35	81,701	38	629,097	7.70
North Carolina	(a)	(a)	(a)	(a)	1,179	1	7,076	6.00
Tennessee	16,642	11	124,204	7.46	34,384	16	259,005	7.53
Other States [b]	11,594	7	91,954	7.93	13,628	6	98,635	7.24
	155,040	100	1,123,950	7.25	214,183	100	1,664,156	7.77

[a] Included under "Other States."

[b] 1922: Alabama, Idaho, Illinois, North Carolina, and South Carolina. 1923: Alabama, California, Kentucky, South Carolina, Virginia, and Wisconsin.

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[1] A chapter on barytes and barium products that was more than ordinarily detailed and was accompanied by a map showing the location of barytes deposits and barium-product manufactories was given in Mineral Resources for 1915.

In general the prices reported were higher than in 1922, Missouri showing the largest increase.

Georgia exceeded Missouri by a small quantity, and Tennessee ranked third. Of the barytes reported by producers in Missouri 94 per cent was shipped from Washington County. The output of North Carolina and South Carolina was much increased. Kentucky, Virginia, and Wisconsin again were listed as producers, and considerable interest was shown in the deposits in Idaho, though no production was made in that State.

IMPORTS AND EXPORTS[2]

The barytes imported in recent years was purchased for use in plants in the eastern part of the United States, and most of it was shipped from Germany. During the war the imports of barytes nearly ceased, but in 1920 and later years they have averaged about the same as in the years before the war.

Crude barytes imported for consumption in the United States, 1901–1923

Year	Short tons	Value [a]	
		Total	Average
1901–1910 (average)	11,224	$38,008	$3.39
1911–1915 (average)	21,833	40,436	1.85
1916	17	245	14.41
1917	6	63	10.50
1918	----------	----------	----------
1919	118	$594	$5.03
1920	24,874	146,858	5.90
1921	11,054	59,371	5.37
1922	23,239	104,680	4.50
1923	15,045	93,721	6.23

[a] Value at port of shipment, on which duty is levied. Does not include railroad and ship freight charges to this country or import duty.

A small quantity of barytes was exported to Canada in 1922, as reported by shippers. Exports of barytes are not separately classified by the Bureau of Foreign and Domestic Commerce.

USE

The two following tables, which show the use of domestic and imported barytes in the United States, were compiled from reports made by the manufacturers of barium products.

Crude barytes (both domestic and imported) used in the manufacture of barium products in the United States, 1918–1923, in short tons

Year	In ground barytes	In lithopone	In barium chemicals	Total
1918	62,440	85,282	38,041	185,763
1919	64,922	103,688	32,976	201,586
1920	79,052	113,181	37,210	229,443
1921	28,296	61,359	10,952	100,607
1922	48,280	94,259	25,303	167,842
1923	47,713	128,547	34,327	210,587

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[2] The statistics of imports and exports were compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce.

Domestic and imported crude barytes used in the manufacture of barium products in the United States in 1923, by States

State	Products manufactured	Plants	Barytes used (short tons)
Pennsylvania	Lithopone and chemicals	5	78,417
Delaware	Lithopone		
New York	Chemicals		
Missouri and Kentucky	Ground barytes	3	40,263
New Jersey	Lithopone and chemicals	3	37,445
Illinois	do	3	20,272
West Virginia and Tennessee	Chemicals	4	19,797
California	Ground barytes, lithopone, and chemicals		
Maryland	Lithopone	3	14,393
Georgia and South Carolina	Ground barytes		
		21	210,587

WORLD'S PRODUCTION

The following table, prepared by W. I. Whiteside, of the United States Geological Survey, shows the output of barytes by various countries so far as statistics are available:

World's production of barytes, 1913, 1919–1923, in metric tons[a]

Country[a]	1913	1919	1920	1921	1922	1923
Algeria	(*b*)	(*b*)	(*b*)	(*b*)	1,200	700
Australia:						
New South Wales	445	641	226	203	----------	102
South Australia	105	1,781	2,583	1,289	1,908	(*b*)
Tasmania	----------	405	1,065	----------	----------	(*b*)
Western Australia[c]	----------	----------	----------	2	384	(*b*)
Austria	(*b*)	(*b*)	(*b*)	2,080	2,140	2,377
Belgium	12,000	----------	15,240	17,050	1,480	(*b*)
Canada	582	425	681	245	262	190
France	12,236	11,861	18,782	11,297	12,634	(*b*)
Germany:						
Baden	16,441	(*b*)	(*b*)	(*b*)	(*b*)	(*b*)
Bavaria	27,192	8,804	7,888	23,439	16,139	(*b*)
Prussia	34,627	54,384	103,976	85,320	(*b*)	(*b*)
Saxony	134	----------	----------	----------	----------	(*b*)
India (British)	----------	2,632	689	1,480	2,430	(*b*)
Italy	12,970	15,920	15,380	13,500	21,300	27,592
Rhodesia, Southern	----------	----------	----------	----------	----------	9
Russia	(*b*)	(*b*)	328	(*b*)	(*b*)	(*b*)
Spain	3,049	11,459	13,773	910	[d] 2,075	11,764
United Kingdom	50,848	61,051	65,180	25,065	41,606	44,195
United States	41,093	189,900	206,940	60,209	140,649	194,303

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[a] Sources of information: Algeria, Bur. Mines, Gov. Gen. of Algeria. Australia, New South Wales, Dept. Mines Ann. Rept.; South Australia, Dept. Mines Min. Review; Tasmania, Acting Sec. Mines Ann. Rept.; Western Australia, Dept. Mines Rept. Austria, Bundesmin. f. Handel u. Gewerbe, Ind. u. Bauten, Mitt. oesterr. Bergbau. Belgium, Statistique des industries extractives et métallurgiques. British India, India Geol. Survey Rec. Canada, Dept. Mines, Mines Branch, Ann. Rept.; Dominion Bur. Statistics Ann. Rept., 1921, and Preliminary Rept., 1922–23. France, Statistique de l'industrie minérale en France et en Algérie; data furnished by Direction des Mines, Ministère des travaux publics, Paris. Germany, Baden, Imp. Mineral Resources Bur., London; Bavaria, Imp. Mineral Resources Bur., London; Glückauf, Aug. 7, 1920, and June 9, 1923; consular report, Mar. 18, 1922; Prussia, Zeitschr. Berg-, Hütten- u. Salinenwesen preuss. Staat.; Saxony, Jahrb. Berg- u. Hüttenwesen im Königreich Sachsen. Italy, Rivista del servizio minerario; consular report Apr. 3, 1924. Rhodesia (Southern), Chamber of Mines Monthly Repts. Russia, Imp. Mineral Resources Bur., London. Spain, Estadística minera de España. United Kingdom, Mines and Quarries, general report with statistics; Mines Dept. Ann. Rept., Sec. Mines and H. M. Chief Inspector Mines.

[b] Data not available.

[c] Exports.

[d] Exclusive of 1,224 cubic meters from quarries.

BARIUM PRODUCTS

The barium-products industry in the United States continued active in 1923, the year's production showing an increase of 8 per cent in quantity over that of 1922 and falling only 12 per cent below the production of 1920, the largest recorded by the Survey. These statistics were first collected for 1915. There was a falling off in the output of ground barytes, but a good gain in that of both lithopone and barium chemicals.

Barium products made from domestic and imported crude ores in the United States and sold, 1922–23

Product	1922			1923		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Ground barytes	46,176	$933,722	$20.22	39,605	$895,095	$22.60
Lithopone	83,360	9,214,040	110.53	98,199	11,608,443	118.21
Barium chemicals [a]	13,901	[b] 1,251,679	[b] 90.04	16,803	1,231,646	73.30
	143,437	[b]11,399,441	[b] 79.47	154,607	13,735,184	88.84

[a] Barium chemicals manufactured from barium products bought in open market are not included in table in order to avoid duplication; the total output of barium chemicals is therefore not shown above.
[b] Revised figures.

REFINED GROUND BARYTES

Barytes is ground to very fine powder, leached with acid, and washed for use as a pigment, a filler, and an inert base. Most barytes is refined by flotation on a stream of water, whereby only the most impalpable powder is obtained. As a pigment it is used chiefly in interior flat white or light-colored paints. As a filler it is extensively used in rubber goods, linoleum, oilcloth, highly glazed paper, and similar white glazed articles. It forms an inert base on which dyes are precipitated to make lakes or colored paints. Ground barytes has also been used in making brick for the construction of X-ray laboratories, in place of a lining of sheet lead, to prevent the rays from escaping and doing possible injury.

The output of ground barytes in 1923 was 14 per cent less than that in 1922. About four-fifths of the output was produced in Missouri, inclusive of a small quantity from Kentucky. The National Pigments & Chemical Co. was the largest producer. A plant in Kentucky resumed production, and a new plant in Missouri began operations at the end of the year.

Ground barytes sold by domestic producers in 1918–1923

Year	Plants	Short tons	Value	
			Total	Average
1918	9	55,086	$1,041,608	$18.91
1919	9	[a]57,985	1,163,437	20.06
1920	8	65,748	1,381,868	21.02
1921	7	27,661	622,871	22.52
1922	7	46,176	933,722	20.22
1923	6	39,605	895,095	22.60

[a] Production, not sales.

Companies grinding barytes in 1923

Company	Location of plant
Western Rock Products Co., San Francisco, Calif.	San Francisco, Calif.
Thompson, Weinman & Co., New York, N. Y.	Cartersville, Ga.
Do	Nicholasville, Ky.
C. P. DeLore Co., St. Louis, Mo.	Mississippi River and River Des Peres, Mo.
Point Milling & Manufacturing Co., Mineral Point, Mo.	Mineral Point, Mo.
National Pigments & Chemical Co., St. Louis, Mo.	St. Louis, Mo.
Cherokee Chemical Co., Kings Creek, S. C.	Kings Creek, S. C.

The average value at the plant of domestic ground barytes sold in the United States in 1923 was $22.60 a ton, as compared to $20.22 in 1922. Western domestic floated ground barytes, including barrels, f. o. b. mills, was quoted in the Oil, Paint, and Drug Reporter at a minimum of $26 a short ton from January to the middle of March; at a minimum of $28 from March 19 to October 29; at a minimum of $24 in November; and at $25 to $26 in December. Domestic southern off-color barytes, in bulk, was quoted at $15 to $20 a ton until October 22 and at $15 to $18 for the rest of the year. Foreign ground barytes, in barrels f. o. b. New York, brought $32 to $40 a short ton in January, $35 to $40 until the middle of March, $40 to $42 through October, and a minimum of $35 in November and December.

Ground barytes sold by domestic producers in 1923, by States

State	Plants	Short tons	Value	
			Total	Average
Missouri and Kentucky	3	32,553	$779,125	$23.93
California, Georgia, and South Carolina	3	7,052	115,970	16.44
	6	39,605	895,095	22.60

LITHOPONE

Lithopone, a pigment prepared chemically from barytes and zinc sulphide ore, is an intimate mixture by chemical precipitation of barium sulphate and zinc sulphide in the proportion of about 70 to 30. It is of exceedingly fine grain and is used in paint especially but also as a filler in rubber goods, linoleum, oilcloth, window shades, and certain kinds of paper.

The quantity of lithopone sold in 1923 was about 18 per cent more than in 1922 and was greater than in any previous year. Pennsylvania led in quantity, and New Jersey was second. Of the total output of the country nearly 90 per cent was made in Pennsylvania, New Jersey, Delaware, and Maryland, as the industry is largely centered around Philadelphia.

Lithopone sold by producers in the United States in 1923, by States

State	Plants	Short tons	Value	
			Total	Average
Pennsylvania and Delaware	4	54, 928	$6, 791, 312	$123. 64
New Jersey and Maryland	4	32, 544	3, 620, 389	111. 25
Illinois and California	3	10, 727	1, 196, 742	111. 56
	11	98, 199	11, 608, 443	118. 21

Lithopone sold by producers in the United States, 1918-1923

Year	Short tons	Value	
		Total	Average
1918	62, 403	$7, 923, 276	$126. 97
1919	78, 365	10, 218, 850	130. 40
1920	89, 373	12, 484, 925	139. 69
1921	55, 016	6, 681, 563	121. 45
1922	83, 360	9, 214, 040	110. 53
1923	98, 199	11, 608, 443	118. 21

Active lithopone plants in the United States in 1923

Company	Location of plant
Metals & Chemicals Extraction Corporation, Oakland, Calif	Oakland, Calif.
Krebs Pigment & Chemical Co., Newport, Del	Newport, Del.
Midland Chemical Co., Chicago, Ill	Argo, Ill.
Sherwin-Williams Co., Cleveland, Ohio	Chicago, Ill.
St. Louis Lithopone Co., Railway Exchange Building, St. Louis, Mo	Collinsville, Ill.
Glidden Co., St. Helena, Baltimore, Md	St. Helena, Md.
E. I. du Pont de Nemours & Co., Wilmington, Del	Newark, N. J.
Do	Philadelphia, Pa.
Grasselli Chemical Co., Cleveland, Ohio	Grasselli, N. J.
United Color & Pigment Co., Newark, N. J	Newark, N. J.
New Jersey Zinc Co., New York, N. Y	Palmerton, Pa. (2 plants).

The Metals & Chemicals Extraction Corporation was in the hands of a receiver and was offered for sale late in the year. The Collinsville Zinc Corporation was reorganized as the St. Louis Lithopone Co., which commenced operations just before the end of the year. The Consolidated Chemical Products Co., of Alton, Ill., was reorganized as the Basic Chemical Manufacturing Corporation and expects to be active in 1924. The Mineral Refining & Chemical Corporation, at Mississippi River and River Des Peres, St. Louis, Mo., was sold under bankruptcy proceedings. Part was purchased by the C. P. DeLore Co., which is producing ground barytes. The remainder of the plant was bought by the Titanium Pigment Co. (Inc.), New York City, which will produce titanox, a white pigment consisting of 16 to 26 per cent of titanium oxide precipitated upon 74 to 84 per cent of barium sulphate.

The average value reported by domestic manufacturers at their plants in 1923 was $118.21 a ton, which is $7.68 more than in 1922 but $3.24 less than in 1921. Values in 1923 ranged from $95 to $131.40 a ton f. o. b. cars at plant. Prices for lithopone delivered in New York in barrels, in car lots, as quoted in the Oil, Paint, and

Drug Reporter, were 6 to 6¾ cents a pound in January, 6½ to 6¾ cents to the middle of March, 7 to 7¼ cents until the middle of December, and 6⅜ to 6⅝ cents until the end of the year.

BARIUM CHEMICALS

The quantity of barium chemicals made in the United States from barytes ore and sold in 1923 was 21 per cent greater than the corresponding quantity in 1922 but less than in 1917 to 1920.

Domestic barium chemicals sold in the United States, 1915–1923, in short tons

Chemical	1915–1919 (average)	1920	1921	1922	1923		
					Short tons	Value	
						Total	Average
Barium carbonate	6, 525	7, 484	1, 956	2, 281	6, 362	$441, 471	$69. 39
Barium chloride	3, 932	3, 084	(a)	2, 022	3, 301	270, 333	81. 89
Barium sulphate (blanc fixe)	5, 125	8, 046	2, 471	[b] 7, 349	6, 761	490, 479	72. 55
Other barium chemicals [a]	2, 681	2, 146	1, 060	[b] 2, 249	379	29, 363	77. 47
	18, 263	20, 760	5, 487	13, 901	16, 803	1, 231, 646	73. 30

[a] The quantities of chemicals manufactured in less than three plants are combined in the table to avoid divulging confidential information, as follows: 1915–1918 and 1920: Binoxide, hydroxide, nitrate, and sulphide; 1919: Binoxide, nitrate, and sulphide; 1921: Chloride, hydroxide, and sulphide; 1922: Binoxide, hydroxide, sulphide, and sulphydrate; 1923: Hydroxide and sulphide.

[b] Revised figures.

Domestic manufacturers of barium chemicals in 1923

[Includes only those using barytes ore]

Company	Location of plant
Metals & Chemicals Extraction Corporation, Oakland, Calif.	Oakland, Calif.
Chicago Copper & Chemical Co., Chicago, Ill.	Blue Island, Ill.
Grasselli Chemical Co., Cleveland, Ohio	Grasselli, N. J.
Titanium Pigment Co. (Inc.), New York, N. Y.	Niagara Falls, N. Y.
E. I. du Pont de Nemours & Co., Wilmington, Del.	Philadelphia, Pa.
Durex Chemical Corporation, New York, N. Y. (New Jersey Zinc Co.)	Sweetwater, Tenn.
Barium Reduction Corporation, New York, N. Y. (succeeding Rollin Chemical Corporation).	South Charleston, W. Va.

The average value reported by manufacturers for barium carbonate sold in 1923 was $2.35 a ton less than in 1922 and $11.86 less than in 1921. Barium chloride brought $0.91 a ton more than in 1922 and $20.31 more than in 1921; barium sulphate brought $2.24 a ton more than in 1922 (revised figures) and $0.35 less than in 1921.

Average quotations on barium chemicals at New York, 1921–1923 [a]

Chemical	Unit	1921	1922	1923
Barium carbonate	Short ton	$45. 00 –$85. 00	$48. 00 –$85. 00	$66. 00 –$90. 00
Barium chlorate, in kegs [b]	Pound	[b]. 40 – . 45	[b]. 14 – . 15	[b]. 14 – . 15
Barium chloride (white crystals), in bags	Short ton	43. 00 –100. 00	50. 00 –115. 00	80. 00 –100. 00
Barium dioxide	Pound	. 22½– . 25	. 22 – . 29	. 18 – . 29
Barium nitrate, in casks	do	. 07 – . 13½	. 06 – . 10¼	. 07½– . 10¼
Barium sulphate (blanc fixe), dry, in barrels	do	. 03¾–	. 04¼–	. 04¼–
Barium sulphate (blanc fixe), pulp	Short ton	30. 00 – 60. 00	40. 00 – 50. 00	40. 00 – 60. 00
Barium binoxide, in drums	Pound	. 19 – . 25	. 18 – . 23	. 18 – . 20

[a] Oil, Paint, and Drug Reporter.

[b] From Jan. 1, 1921, to July 24, 1922, "per pound," 40–45 cents; from July 24, 1922, to Dec. 31, 1923, "in kegs, per pound," 14–15 cents.

IMPORTS AND EXPORTS

Germany has been the chief source of barytes and barium products imported into the United States. The World War naturally shut off this trade, and during 1918 a few hundred tons of ground witherite made up the total imports of barium in any form. Importation was resumed in a small way in 1919 but by 1922 was considerably greater than before the war, the imports of lithopone in particular being several times larger. The imports in 1923 were in general less than in 1922.

Barium compounds imported for consumption in the United States, 1919–1923

[Value at port of shipment]

Year	Ground barytes			Lithopone			Barium binoxide		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per pound		Total	Average per pound
1919				739	$122, 708	$0. 083			
1920	274	$3, 017	$11. 01	1, 714	263, 240	. 077	251	$64, 447	$0. 128
1921	1, 002	16, 942	16. 91	5, 247	432, 019	. 041	669	127, 631	. 095
1922	4, 696	59, 453	12. 66	10, 763	885, 671	. 041	1, 009	189, 334	. 094
1923	6, 022	88, 741	14. 74	10, 440	776, 383	. 037	905	152, 270	. 084

Year	Blanc fixe (precipitated barium sulphate)			Artificial barium carbonate (chemically precipitated)			Natural barium carbonate (ground witherite)		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound		Total	Average per pound
1919	[a] 1	$90	$0. 070	4	$2, 666	[b] $0. 312	112	$4, 739	$0. 021
1920	165	8, 485	. 026	476	37, 462	. 039	1, 510	61, 284	. 020
1921	769	22, 470	. 015	2, 238	80, 603	. 018	668	25, 188	. 019
1922	2, 187	76, 445	. 017	5, 212	210, 250	. 020	1, 472	39, 114	. 013
1923	587	32, 063	. 027	1, 901	79, 482	. 021	1, 557	41, 823	. 013

Year	Barium chloride			Barium nitrate			Barium hydroxide		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound		Total	Average per pound
1919	550	$19, 846	$0. 018	(c)			(c)		
1920	1, 595	151, 778	. 048	(c)			(c)		
1921	2, 186	72, 621	. 017	(c)			(c)		
1922	1, 962	112, 785	. 029	[d] 179	$16, 795	$0. 047	[d] 73	$6, 573	$0. 045
1923	1, 278	75, 014	. 029	511	59, 766	. 058	181	16, 872	. 047

[a] 1,285 pounds.
[b] Probably error in record.
[c] Not separately enumerated prior to new tariff.
[d] Sept. 22 to Dec. 31; not separately enumerated prior to new tariff.

The exports of lithopone are considerable, though not so large as the imports.

Lithopone exported from the United States, 1922–23[a]

Year	Short tons	Value
1922	1,616	$169,982
1923	1,485	176,624

[a] Exports not separately enumerated prior to 1922.

MARKETS AND PRICES

The chief center for barytes consumption in the East is in the region near New York and Philadelphia, in which the prices are based on quotations at New York. In the Middle West barytes is consumed mainly about Chicago and St. Louis, where the prices are

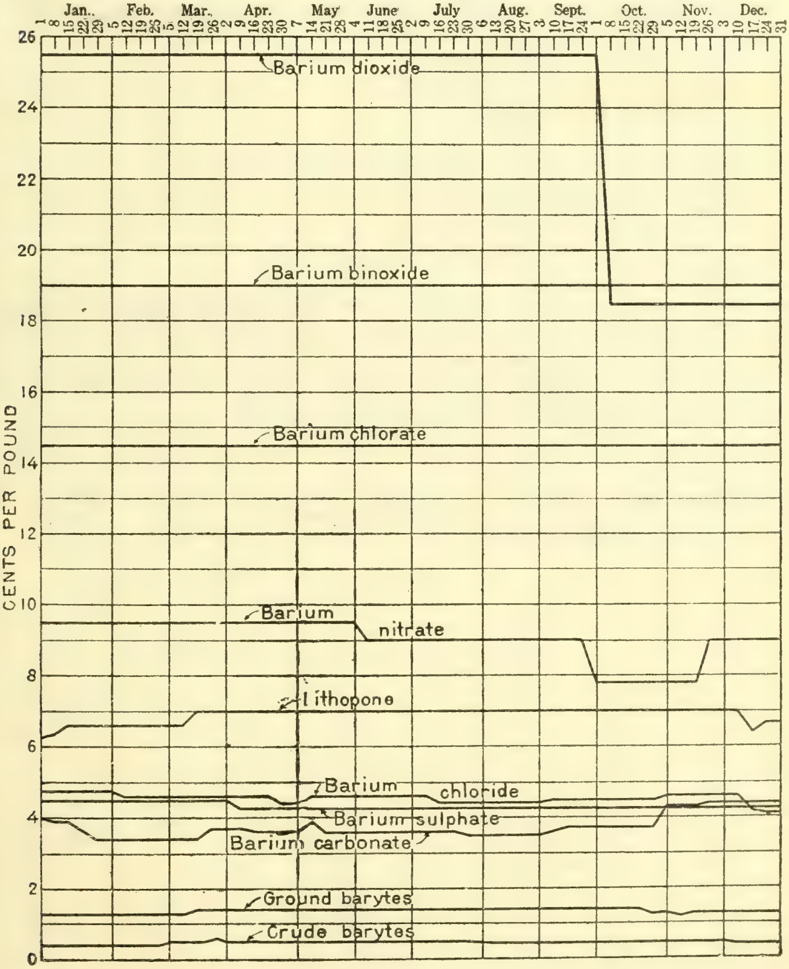

FIGURE 7.—Weekly quoted prices of crude barytes and of barium products and barium chemicals, 1923

based on quotations at St. Louis, which is close to the barytes fields of Missouri. The price of barium products is based on quotations at New York.

Figure 7 shows graphically the weekly average New York prices quoted for barium products and, for comparison, the price of crude barytes f. o. b. mines. The quotations on barytes, crude and ground, and on barium carbonate, usually expressed in lots of short tons, are reduced to prices per pound for convenience in plotting the graphs. All prices except those of crude barytes are taken from the Oil, Paint, and Drug Reporter. The prices quoted for crude barytes are taken from Chemical and Metallurgical Engineering.

The qualities and conditions of the barytes and barium products and chemicals included in the graphs of prices are designated as follows:

Crude barytes, "f. o. b. mines, bulk."
Ground barytes, "western domestic floated, including barrels, f. o. b. mills."
Lithopone, "in barrels, car lots."
Barium chlorate, "kegs."
Barium chloride, "crystals, bags."
Barium dioxide, "drums."
Barium nitrate, "casks."
Barium sulphate (blanc fixe), "dry, less than car lots."
Barium carbonate, "bags."
Barium binoxide, "drums."

CUSTOMS DUTIES

The tariff act of 1922 contains the following paragraphs relating to duties levied on imports of barytes and barium compounds:

Par. 12. Barium carbonate, precipitated, 1 cent per pound; barium chloride, 1¼ cents per pound; barium dioxide, 4 cents per pound; barium hydroxide, 1¼ cents per pound; and barium nitrate, 2 cents per pound.

Par. 69. Barytes ore, crude or unmanufactured, $4 per ton; ground or otherwise manufactured, $7.50 per ton; precipitated barium sulphate or blanc fixe, 1 cent per pound.

Par. 79. * * * Lithopone, and other combinations or mixtures of zinc sulphide and barium sulphate, 1¾ cents per pound.

Par. 1698. Witherite (natural barium carbonate), free of duty.

CARBON BLACK PRODUCED FROM NATURAL GAS

By G. B. Richardson

The production of carbon black from natural gas in the United States in 1923 amounted to 138,262,648 pounds, an increase of 104 per cent over the production in 1922. The increase resulted from the expansion of the industry that followed the greater demand in 1922 for carbon black by rubber companies. The number of producers of carbon black reporting to the Survey increased from 26 in 1922 to 47 in 1923, and the number of plants operated from 43 to 69. The operations resulted in overproduction during the later part of 1923, as indicated by the quantity of stocks held in the hands of producers. Stocks increased from 2,434,547 pounds on January 1, 1923, to 38,320,814 pounds on December 31.

The production by States in 1923 as compared with that in 1922 is shown in the following table. Louisiana led all the States in the quantity of carbon black produced, as it has in the last three years, and its output of more than 101,000,000 pounds shows an increase of 142 per cent over its output in 1922. The production of Kentucky in 1923 increased 134 per cent. The production of West Virginia, on the other hand, declined slightly. Texas joined the States producing carbon black in 1923. The production of Wyoming, Oklahoma, Montana, and Pennsylvania, which ranked in the order named, is grouped together to avoid revealing the operations of individual companies.

Carbon black produced from natural gas in the United States in 1922–23

State	Producers reporting	Number of plants	Quantity (pounds)	Value at plant		Estimated quantity of natural gas used (M cubic feet)	Average yield per M cubic feet (pounds)
				Total	Average (cents)		
1922							
Louisiana	14	18	41, 966, 856	$3, 564, 393	8. 5	38, 004, 000	1. 1
West Virginia	11	18	20, 095, 481	1, 714, 576	8. 5	12, 087, 000	1. 7
Kentucky	3	3	4, 306, 875	416, 549	9. 7	2, 300, 000	1. 9
Oklahoma	1	1	1, 425, 917	124, 100	8. 7	1, 238, 000	1. 2
Wyoming	1	1					
Montana	1	1					
Pennsylvania	1	1					
	[a] 26	43	67, 795, 129	5, 819, 618	8. 6	53, 629, 000	1. 3
1923							
Louisiana	29	35	101, 398, 881	8, 415, 566	8. 3	82, 974, 000	1. 2
West Virginia	11	20	20, 038, 415	1, 983, 385	9. 9	13, 722, 000	1. 5
Kentucky	6	6	10, 058, 887	758, 091	7. 5	5, 906, 000	1. 7
Texas	3	3	2, 633, 013	183, 306	7. 0	2, 136, 000	1. 2
Wyoming	2	2	4, 133, 452	351, 718	8. 5	4, 358, 000	. 9
Oklahoma	1	1					
Montana	1	1					
Pennsylvania	1	1					
	[a] 47	69	138, 262, 648	11, 692, 066	8. 5	109, 096, 000	1. 3

[a] In counting the total number of producers a producer operating in more than one State is counted only once.

Summary of statistics of carbon black from natural gas in the United States, 1919–1923

	1919	1920	1921	1922	1923
Number of producers	17	19	23	26	47
Number of plants	36	35	41	43	69
Quantity produced:					
Louisiana pounds	14, 024, 606	18, 565, 498	31, 003, 615	41, 966, 856	101, 398, 881
West Virginia do	29, 925, 614	26, 659, 469	25, 073, 000	20, 095, 481	20, 038, 415
Other States do	8, 106, 721	6, 096, 925	3, 689, 700	5, 732, 792	16, 825, 352
Total do	52, 056, 941	51, 321, 892	59, 766, 315	67, 795, 129	138, 262, 648
Value at plants:					
Total dollars	3, 816, 040	4, 032, 286	5, 445, 878	5, 819, 618	11, 692, 066
Average per pound cents	7. 3	7. 9	9. 1	8. 6	8. 5
Estimated quantity of natural gas used, M cubic feet	49, 896, 000	40, 599, 000	50, 565, 000	53, 629, 000	109, 096, 000
Average yield per M cubic feet pounds	1. 0	1. 3	1. 2	1. 3	1. 3

GRAPHITE

By Jefferson Middleton

INTRODUCTION

The domestic graphite-mining industry in the United States in 1923 profited by the general prosperity of that year and made considerable gain in output. Both quantity and value showed large increases compared with 1922, though they did not of course reach the high figures of the war period. Imports followed the same general trend, and exports of domestic graphite also showed a large increase. Prices remained about the same as in 1922.

The occurrence, properties, and uses of graphite have been discussed so thoroughly in previous volumes of Mineral Resources that repetition is not necessary. For those interested in these phases of the subject the following list of some of the more important papers is given:

Graphite, by J. H. Pratt: Mineral Resources, 1904, pp. 1157–1167, 1905.

Graphite [properties, origin, uses, deposits, artificial graphite, bibliography], by E. S. Bastin: Mineral Resources, 1908, pt. 2, pp. 717–738, 1909.

Graphite [properties, origin, uses, deposits, artificial graphite, bibliography], by E. S. Bastin: Mineral Resources, 1909, pt. 2, pp. 809–840, 1911.

Graphite [properties, origin, manufactured graphite, uses, foreign deposits, with map of Ceylon, bibliography], by E. S. Bastin: Mineral Resources, 1911, pt. 2, pp. 1079–1112, 1912.

Graphite [foreign deposits, bibliography], by E. S. Bastin: Mineral Resources, 1913, pt. 2, pp. 181–251, 1914.

Graphite [select bibliography], by E. S. Bastin: Mineral Resources, 1914, pt. 2, pp. 159–174, 1916.

Graphite [bibliography], by H. G. Ferguson: Mineral Resources, 1917, pt. 2, pp. 97–101, 1920.

Graphite [foreign deposits, map showing principal deposits of the world, bibliography], by H. G. Ferguson: Mineral Resources, 1918, pt. 2, pp. 223–265, 1921.

Graphite, by L. M. Beach, with a history of graphite mining in Pennsylvania, by F. Bascom: Mineral Resources, 1919, pt. 2, pp. 309–324, 1922.

Foreign graphite, by A. H. Redfield: Mineral Resources, 1919, pt. 2, pp. 181–210, 1922.

These reports are not available for free distribution, but may be consulted in the principal libraries of the United States.

Two papers published by the Bureau of Mines [1] indicate that superior pots for melting steel and brass may be made of domestic graphites and bond clays.

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[1] Stull, R. T., and Bole, G. A., Graphite for steel-melting crucibles: Bur. Mines Repts. Inv. 2512, August, 1923. Stull, R. T., and Geyer, L. E., Graphite for brass-melting crucibles: Bur. Mines Repts. Inv. 2542, November, 1923.

A recent statement by Prof. Benjamin Le Roy Miller,[2] of the department of geology, Lehigh University, is a good résumé of the graphite situation and is quoted in full below.

In the discussion of the present situation with reference to almost any of our economic mineral products it is necessary to review the records of the past 10 years or more for a proper appreciation of present conditions. The pre-war, war, and postwar periods afford striking contrasts in practically every industry based on our raw minerals, and so rapidly did we pass from one period to another that it is not surprising to find a great unsettling of conditions and consequent hardships resulting. Graphite was one of the important war minerals, although a minor one from the standpoint of quantity consumed, and the graphite industry accordingly responded quickly to the enormously increased demand occasioned by the war and slumped with equal rapidity at its sudden termination. The pre-war situation was simple, the war problems complex and confused, and the postwar conditions demoralizing.

Graphite is distinctly an international mineral product. It is found in almost every country in the world but is not mined for export in most of them and is utilized in any considerable quantities only in the manufacturing countries of western Europe and the United States. Indeed, two of the countries where there are extensive graphite-manufacturing interests, France and England, have been entirely dependent upon foreign supplies of graphite, and every manufacturing country in pre-war times looked to one or more foreign countries for the supply of certain kinds of graphite.

During the war several of the countries attempted to make themselves independent through the development of domestic mines. Germany, because of necessity, succeeded in doing so, and the United States made strong strides in that direction, while France was able to dispense with practically all foreign supplies other than that obtained from its colony Madagascar. In the period following the armistice there has been a tendency to return to pre-war usages, yet not entirely, as the stream of trade once diverted seldom returns to the old channel.

The crystalline graphite of international importance is produced in Ceylon, Madagascar, the United States, and Canada and is mainly used in the manufacture of crucibles for the steel and brass industries, with the poorer grades used for lubricants, paint, stove polish, and foundry facings. Amorphous graphite comes mainly from Czechoslovakia (Bohemia principally, but some from Moravia), Austria, Chosen (Korea), Italy, the United States, and Mexico and is used for foundry facings, lubricants, stove polish, pencils, and paint. Artificial (or manufactured) graphite is made only in the United States and is principally used in the production of electrodes.

In addition to this classification we must recognize different varieties. Of crystalline graphite there are two distinct kinds, each adapted for a particular use. Ceylon produces vein graphite that has long been considered so superior to any other form of graphite for crucible manufacture that it has dominated in that field. In Montana there is a deposit of similar material, but up to the present time of little economic importance. Madagascar, the United States, and Canada produce mainly a variety of crystalline graphite that occurs as disseminated thin flakes in highly metamorphosed rocks.

Before the war flake graphite was used sparingly for crucibles, but, due to the difficulty of getting the Ceylon variety during the war, French, German, and Austrian graphite-crucible manufacturers substituted flake graphite almost entirely, and in England and the United States the manufacturers used the flake material in larger proportions than before. Certainly there has been a change of sentiment in regard to the necessity of Ceylon graphite for crucibles, although in the United States the crucible manufacturers seem to still favor it rather than the domestic or Madagascar flake that is more easily obtainable. This is true in spite of the fact that experiments conducted by the United States Bureau of Mines have seemed to indicate that domestic flake graphite from Alabama was equal if not superior to the Ceylon variety. If this is true, the situation of the manufacturers clinging to the continued use of a higher-priced and perhaps inferior product is an anomalous one and may be due to their conservatism or to their lack of knowledge as to how to get the best results from flake graphite. Whatever the explanation, it is certain that they are still unconvinced that they can entirely substitute the flake variety for the Ceylon without injuring the quality of their crucibles, and at the present time there is not sufficient evidence to say whether they are right or wrong.

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[2] The graphite situation: Cement, Mill, and Quarry, vol. 24, No. 4, pp. 78–79, Feb. 20, 1924.

The users of amorphous graphite are less discriminating, but they, too, show preferences for the products of certain countries for special purposes. The best example of this is the Mexican graphite, formed by the metamorphism of a coal bed brought about by an intrusion of igneous rock, which is preferred above all other graphite by the pencil manufacturers of the world.

The graphite industry of the United States has had its ups and downs to probably a greater degree than any one of our other mineral industries. Indeed, so much money has been lost in graphite ventures in Canada, New York, Pennsylvania, Alabama, and Texas that among many people the mineral itself is no blacker than the reputation of the graphite industry. In every one of these regions abandoned mines and decaying concentrating mills bear witness to the unwise investments of capital. In fact, it is doubtful whether among the hundred or more companies formed to exploit the domestic graphite deposits there are more than four or five that have returned the capital invested, and many a man has congratulated himself when he has succeeded in selling his interests to someone less familiar with the difficulties of the business.

In many cases the history is about as follows: The discovery of graphite-bearing rock leads to the formation of a company in which all the stockholders are certain that the profits will be extremely high, due to the early capture of all the American markets supplied by foreign concerns. A mill for concentrating the graphite is soon built at a cost of from $25,000 to $75,000 and operations started. After a few days of operation the mill is closed to make adjustments or to replace portions of the machinery in order to effect a more complete recovery or to produce a better product. In some cases for years short periods of running and long periods of repairing and refitting go on, until the working capital is exhausted, the stockholders are disgusted and unwilling to advance more money, and the operations cease. Reorganizations with new capital may be effected, but the same procedure of partial or complete overhauling of the mill equipment at frequent intervals continues.

The war brought about great changes due to the immense demand for crucible graphite and the difficulty of obtaining the foreign product from Ceylon and Madagascar. There was renewed activity and the development of many new properties in the domestic production, especially in Alabama and Texas, followed by almost complete stagnation, which still exists.

The reserves of domestic flake graphite in the United States are very large, more than ample to supply the needs of our consumers for a long period of time. Alabama probably has the largest reserves, with New York, Pennsylvania, and Texas also possessing extensive deposits. The war expansion was confined almost entirely to Alabama and Texas. In the former State large sums of money were invested in expensive mills, and at the close of the war the capacity of the plants was far in excess of the country's needs. Milling methods were being improved, and there was an approach to standardization in the use of oil-flotation processes. When peace came the graphite manufacturers had on hand large stocks of crucibles and raw graphite, and the graphite producers also had large stocks in storage produced at high cost. The demand for crucibles and consequently for raw graphite decreased to almost nothing, and bankruptcy soon faced most of the operators. Graphite that actually cost 14 to 16 cents a pound to produce could not be sold for half that amount.

The domestic industry might have been revived in a few years if it had not been for the large stocks of Madagascar flake that continued to come in. In prewar days it was not necessary to reckon with Madagascar, although imports from that island began to come into the United States in 1908. During the war we first appreciated the importance of that country as a factor in the graphite industry. The deposits are extensive, estimated to be able to furnish from 20,000,000 to 100,000,000 tons of graphite concentrates, and the conditions of mining and concentration are so favorable that it has thus far been possible to put the material in New York at less than the cost of the domestic product. When this situation appeared as a menace to the graphite producers of this country there was a clamor for the levy of a heavy import tariff to avoid the destruction of the domestic industry. Congress responded to the appeal by placing a tariff on imported graphite as follows: Amorphous graphite, 10 per cent ad valorem; crystalline lump, chip, or dust, 20 per cent ad valorem; crystalline flake, 1½ cents per pound.

The imposition of this tariff on imports has now been proved to be ineffective, and there is a renewed demand for higher rates. During 1923 some of the best Madagascar graphite after payment of duty sold in New York for 4 cents a pound less than the cost of production of domestic flake, and the best grade of Ceylon was not much higher. An average of the prevailing New York prices for Ceylon graphite, including duty, was lump, 6 cents; chip, 4¾ to 5 cents; and dust, 3 to 3½ cents. In New York the mine of the [Joseph] Dixon Crucible Co. that long held the record for continuous production has been closed. There was slight activity in Alabama and Texas. However, the Madagascar product dominates the situation.

The outlook for the future of the flake graphite industry is not promising. If the President raises the tariff rates according to the provisions of the flexible tariff law the situation may be improved, but though he should increase the rates to the permissible limit there are probably few companies that can even then compete with the Madagascar producers.

The situation with reference to the amorphous-graphite industry is more favorable. Rhode Island, Michigan, Nevada, and California continue a limited production for foundry facings, paint, and other purposes. The only foreign country that offers serious competition is Chosen (Korea), where a product more desirable for certain purposes is produced, but it can not be marketed at as low a cost as the domestic supply.

PRODUCTION

The sales of domestic graphite in the United States rose from 3,125 short tons in 1922 to 6,038 tons in 1923, an increase of 93 per cent. Of this increase the amorphous variety contributed 1,856 tons, which was a gain of 84 per cent, and the crystalline variety contributed 1,057 tons, a gain of 114 per cent. By considering the sales of graphite in five-year periods the effect of the war is clearly discernible. The average total production for the five-year period from 1909 to 1913 (exclusive of graphitic slate from Georgia) was 3,999 short tons; during the war period, from 1914 to 1918, it was 8,745 tons; and from 1919 to 1923 it was 5,706 tons. It will thus be seen that the average of sales during the war period was more than twice as great as that of the preceding five-year period and more than 50 per cent greater than that of the following five-year period. Imports of graphite during the same periods increased from a five-year average of 24,345 short tons for 1909–1913 to 30,014 tons for 1914–1918 and declined to 17,565 tons for 1919–1923.

Domestic natural graphite sold in the United States, 1918–1923

Year	Number of active operators reporting	Amorphous		Crystalline	
		Short tons	Value	Pounds	Value
1918	42	6, 560	$69, 455	12, 861, 839	$1, 454, 799
1919	20	3, 379	47, 716	8, 086, 191	731, 141
1920	17	4, 694	49, 758	9, 632, 360	576, 444
1921	8	1, 842	20, 860	1, 189, 523	75, 664
1922	7	2, 200	(a)	1, 849, 766	85, 242
1923	7	4, 056	39, 560	3, 964, 900	151, 434

[a] Survey not at liberty to publish value.

MANUFACTURED GRAPHITE

Graphite is manufactured by the Acheson Graphite Co., at Niagara Falls, N. Y. The figures given below, published by permission of this company, represent only the manufactured graphite that comes into competition with natural graphite.

Graphite manufactured by the Acheson Graphite Co., 1918–1923, in pounds

1918	9, 182, 272	1921	5, 888, 000
1919	8, 163, 177	1922	13, 031, 926
1920	7, 399, 749	1923	26, 761, 015

IMPORTS AND EXPORTS [3]

The reports of the Bureau of Foreign and Domestic Commerce as to imports show only the country shipping the goods, which is not invariably the country of origin. For example, the graphite entered in that bureau's statements as imported from France probably originated in Madagascar, and that imported from Great Britain should probably be credited to Ceylon and possibly in part to Madagascar. The shipments from Japan probably consisted of graphite from Chosen. In the table below the graphite imported from the United Kingdom has been arbitrarily credited to Ceylon, that imported from France to Madagascar, and that imported from Japan to Chosen. Imports of more doubtful origin are included under "Other countries."

Graphite imported into the United States, 1918–1923, by countries

[General imports]

Country of origin	1918	1919	1920	1921	1922	1923
Short tons						
Ceylon	9,029	9,451	9,204	2,311	7,258	7,252
Madagascar	970	10,016	4,710	1,078	1,305	1,026
Canada	3,084	1,504	2,170	687	533	893
Brazil	45					
Mexico	5,600	5,506	3,659	3,404	2,197	5,765
Chosen (Korea)	568	126	810	646	1,170	3,811
Italy	17	22	137	47	35	474
Austria			58			59
Germany			30		6	4
Other countries	185	1	317	10	102	533
	19,498	26,626	21,095	8,183	12,606	19,817
Value						
Ceylon	$2,397,735	$1,530,281	$1,077,290	$199,440	$332,195	$393,750
Madagascar	265,338	1,205,350	286,383	67,509	52,275	37,322
Canada	236,226	102,163	157,015	48,035	17,392	37,384
Brazil	7,351					
Mexico	134,183	135,464	131,832	120,153	40,954	41,339
Chosen (Korea)	24,455	3,948	29,936	15,145	29,819	59,174
Italy	628	663	5,072	1,019	1,045	7,487
Austria			1,195			1,364
Germany			2,502		425	389
Other countries	26,559	227	20,087	775	6,856	28,127
	3,092,475	2,978,096	1,711,312	452,076	480,961	606,336

In 1923 the imports of graphite for consumption increased 6,946 tons, or 56 per cent in quantity, and $141,073, or 30 per cent in value, compared with 1922. Compared with the pre-war five year average of 24,345 tons the quantity imported in 1923 showed a decrease of 20 per cent, and compared with the maximum quantity imported—42,930 tons in 1916—there was a decrease of 55 per cent.

Graphite imported for consumption in the United States, 1914–1923

Year	Short tons	Value	Year	Short tons	Value
1914	21,990	$1,398,209	1919	26,626	$2,978,096
1915	23,075	2,241,163	1920	21,095	1,711,312
1916	42,930	7,279,883	1921	8,183	452,076
1917	42,577	8,961,988	1922	12,488	473,046
1918	19,498	3,092,475	1923[a]	19,434	614,119

[a] Composed of "amorphous," 11,252 tons, $149,831; "crystalline chip or dust," 7,243 tons, $426,417; and "crystalline flake," 939 tons, $37,871. Classes not separately shown for earlier years.

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[3] The figures showing imports and exports were compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Graphite exported from the United States, 1918–1923

Year	Unmanufactured graphite		Manufactures of graphite	Year	Unmanufactured graphite		Manufactures of graphite
	Pounds	Value			Pounds	Value	
1918	1,907,719	$121,555	$731,518	1921	1,841,578	$95,998	$679,359
1919	1,258,040	90,185	788,755	1922	1,138,708	78,094	[a] 255,019
1920	1,213,616	112,771	610,261	1923	1,815,292	138,542	[a] 335,778

[a] Exclusive of crucibles, figures for which are not available.

The quantity of graphite exported annually from the United States is comparatively small. In 1923 the exports of unmanufactured graphite increased 59 per cent in quantity and 77 per cent in value compared with 1922. The average value increased from 6.86 cents a pound to 7.63 cents. The value of manufactured graphite exported showed an increase of 32 per cent.

The exports of lead pencils and pencil leads are not included in the tables showing value of manufactured graphite, nor are those of crucibles for 1922 and 1923. Exports of pencils other than metal-casing lead pencils and pencil leads in 1923 were 10,035,600 dozen, valued at $1,636,417. The Bureau of Foreign and Domestic Commerce groups the exports of crucibles as "Crucibles, clay and graphite," hence no figures for exports of graphite crucibles are available. Under this heading 463,265 crucibles, valued at $132,228, were exported in 1923. The corresponding figures for 1922 were 355,155 crucibles, valued at $92,273.

PRICES

In 1923 the price of domestic crystalline graphite at the mine ranged from 3 to 6.4 cents a pound, compared with 4 to 5 cents in 1922. The average price of domestic crystalline graphite at the mine was 3.8 cents a pound, or 0.8 cent less than in 1922.

The following table is based on information furnished by importers prior to 1920. Since then the figures have been furnished by Mr. Charles Pettinos, of New York.

Average prices of Ceylon graphite c. i. f. New York, 1914–1923

[Cents per pound]

Year	Lump		Chip		Dust		Remarks
	First grade	Second grade	First grade	Second grade	First grade	Second grade	
1914	6½– 9½	7½– 8½	7¼– 7¾	6½– 7	4¾– 5¼	3½– 4	Low first half; high second half.
1915	9⅝–20	8 –14	7 –14	6½–12	7½– 9½	6½– 9½	Do.
1916	20 –28	14 –21	13½–20	11½–17	9½–12	9½–10	Do.
1917	28 –32	21 –23	20 –23	17 –19	11 –13	10 –12	High level maintained throughout the year.
1918	15¼–28½	14 –22	12½–21½	11 –18½	10½–12	9 –10	High first half; low second half.
1919	14 –15¼	12 –13	10 –11	8 – 9	6¾– 7½	5 – 6	Low throughout the year.
1920	9 –14	7 –11	7 –10	5½– 7½	5 – 7	3½– 5	High first half; low second half.
1921	5½– 6	4½– 5	4½– 5	3½– 4	3¼– 3¾	2 – 2½	Low throughout the year.
1922	5 – 6	4 – 4½	3¾– 4¼	3¼– 3¾	3 – 3½	2 – 2½	Do.
1923	5 – 6	4 – 4½	3¾– 4¼	3¼– 3¾	3 – 3½	2 – 2½	Do.

WORLD'S PRODUCTION

The following table, prepared by W. I. Whiteside, shows, so far as figures are available, the production of graphite throughout the world. The most striking features of this table are the large increases in production, compared with 1922, in Madagascar, 4,093 tons (61 per cent), and Mexico, 3,435 tons (167 per cent); and the large decreases in Austria, 4,631 tons (33 per cent), and Chosen, 4,554 tons (24 per cent).

World's production of natural graphite, 1919–1923, in metric tons

Country [a]	1919	1920	1921	1922	1923
Australia:					
New South Wales	102	41	----------	51	----------
Western Australia [b]	----------	13	----------	----------	(c)
Austria	8, 265	11, 543	13, 280	14, 034	9, 403
Brazil [b]	2	----------	(d)	----------	(c)
British East Africa (Kenya)	(c)	(c)	254	(c)	(c)
Canada	1, 234	1, 987	850	590	1, 010
Ceylon [b]	6, 779	9, 353	4, 419	11, 024	10, 840
Czechoslovakia	30, 547	22, 925	13, 522	10, 500	(c)
Chosen [b]	12, 923	18, 228	8, 002	19, 330	14, 776
Finland	30	27	(c)	(c)	(c)
France	650	272	1, 100	(c)	(c)
Germany	30, 525	20, 639	[e] 24, 565	[e] 32, 342	(c)
Greenland	(c)	[f] 1, 380	2, 000	432	60
India (British)	129	102	25	20	(c)
Indo-China [b]	7, 451	----------	----------	----------	(c)
Italy	7, 626	5, 398	5, 233	4, 546	5, 691
Japan	1, 950	1, 133	900	1, 046	(c)
Madagascar	4, 983	14, 425	6, 220	6, 675	10, 768
Mexico	4, 023	2, 992	2, 911	2, 054	5, 489
Norway	----------	10	----------	----------	(c)
Spain	1, 958	6, 315	2, 772	530	(c)
Sweden	----------	7	----------	----------	(c)
Union of South Africa	78	66	43	38	54
United States:					
Amorphous	3, 065	4, 258	1, 671	1, 996	3, 680
Crystalline	3, 668	4, 369	540	839	1, 798

[a] *Sources of information.*—Australia: New South Wales, Dept. Mines Ann. Rept.; Western Australia, Dept. Mines Rept. Austria: Bundesmin. f. Handel u. Gewerbe, Ind. u. Bauten, Mitt. u. oesterr. Bergbau. Brazil: Commercio exterior do Brasil. British East Africa (Kenya): Imp. Mineral Resources Bur., London. British India: India Geol. Survey Rec. Canada: Dept. Mines, Mines Branch, Ann. Rept.; Dominion Bur. Statistics Ann. Rept. 1921, Preliminary Repts. 1922–1923. Ceylon: Data furnished by Insp. Mines, Govt. of Ceylon; consular report Feb. 26, 1924. Chosen: Table of Trade and Shipping. Czechoslovakia: State Bur. Statistics Rept. Finland: Data furnished by Industristyrelsen through United States consul. France: Statistique de l'industrie minérale en France et en Algérie; data furnished by Direction des mines, Ministère des travaux publics, Paris. Germany, Vierteljahrshefte zur Statistik; Glückauf, June 9, 1923; consular report July 1, 1923. Greenland: Data furnished by Director of Greenland colonies through United States consul. Indo-China: Consular report April 9, 1921. Italy: Rivista del servizio minerario; consular report April 3, 1924. Japan: Data furnished by the United States embassy, Tokyo; Oil, Paint, and Drug Reporter, July 9, 1923. Madagascar: Statistique de l'industrie minérale en France et en Algérie; Bull. mines. Mexico: Bol. minero, Departamento de minas; Secretaría de hacienda y crédito público, Departamento de impuestos especiales. Norway: Bergverksdrift, Norges Offisielle Statistikk. Spain: Estadística minera de España. Sweden: Bergshantering, Sveriges officiella Statistik. Union of South Africa: Sec. Mines Ann. Rept.; Dept. Mines and Ind. Monthly Rept.

[b] Exports.

[c] Data not available.

[d] Less than one-half ton.

[e] Bavaria only.

[f] Estimated.

FULLER'S EARTH

By Jefferson Middleton

GENERAL CONDITIONS

The progress in the fuller's earth industry indicated in the report for 1922 continued in 1923, the production being the largest recorded and 7 per cent larger than that of 1922. There has been a steady increase in the production of fuller's earth since 1912, except in 1921, when there was a sharp decline of 18 per cent, but this was more than overcome in 1922 and 1923. The output in 1923 was nearly four times as large as that of 1913. The value of fuller's earth in 1923 was the third largest recorded, being exceeded by that of 1920 and 1922. It was only 2 per cent less than that of 1922 and 10 per cent less than that of 1920 but was 14 per cent greater than that of 1921 and six times as great as that of 1913. Since 1920 there has been a steady decline in average value per ton. Notwithstanding this decline, the value for 1923—$15.07—was higher than that of any year prior to 1919. Imports decreased markedly in 1923, the quantity being the lowest in more than 25 years.

The Department of Commerce does not report the exports of fuller's earth, but five operators reported that about 3,700 tons was exported to Canada, Cuba, Denmark, Dutch East Indies, Egypt, England, France, Germany, Holland, India, Mexico, Poland, Scotland, South America, and Sweden. This would indicate a domestic consumption in 1923 of about 154,000 tons, of which the domestic supply constituted about 94 per cent.

OCCURRENCE

Fuller's earth has been reported as occurring in Alabama, Arizona, Arkansas, California, Colorado, Florida, Georgia, Illinois, Massachusetts, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New York, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Virginia, and Washington, but in 1923 it was produced only in Alabama, Florida, Georgia, Illinois, Massachusetts, and Texas. Plants in Arkansas and Pennsylvania that reported production in 1922 were idle in 1923.

USES

Fuller's earth is used principally as a filtering medium in the clarifying or bleaching of fats, greases, and mineral and vegetable oils. Its original use was in the fulling of cloth, from which it derived its name. This use, however, at least in this country, has almost been abandoned. Fuller's earth is also said to be used in the manufacture of pigments for printing wall paper, in detecting certain coloring matters in some food products, as a substitute for talcum powder, and in medicine as a poultice and as an antidote for alkaloid poisons. Another suggested use is in deliming hides in the manufacture of leather. It has also been stated that the fuller's earth cake from oil mills can be used in the manufacture of hand soaps, concrete, waterproofing, and asphalt preparations.[1]

As of general interest the following is quoted from an article by Maynard and Mallory[2]:

> Fuller's earth can be defined as a highly siliceous clay, usually indurated, which has the property of adsorbing certain organic coloring matters from vegetable and mineral oils. This property, which defines the earth and is indicative of its value, can be determined only by actually filtering the oil in the laboratory.
>
> The American earths have been found more desirable for the refining of petroleum, while the English earth has been regarded as better adapted for the bleaching of edible oils. American earths have been found of distinctly superior bleaching power to English earth with the vegetable oils as well, but they have failed to displace the English earth on account of the dependable uniformity of the imported earth, thus assuring the refiner a standard of bleach, uniform filtering, and reliably low oil-retention properties.
>
> Very little has been published regarding the treatment and preparation of the English earth, but it has recently been determined by the writers that certain of the American earths can be commercially prepared, so that the bleaching properties, filtering, and oil adsorption are equally as dependable and these qualities found more desirable than those of the English earth.
>
> * * * * * * *
>
> Fuller's earth is characterized by its light weight, due to the proportion and nature of the pore space. Sand in varying amounts is usually present as well as some mica and in places calcium carbonate in the form of fragments of shells. The earth is conchoidal in fracture, usually indurated, and does not slake in water. It is brittle and not plastic until ground. The earth varies in color from gray to blue, and brown to greenish and yellow. The yellow earth has passed through extreme processes of oxidation, and in some areas the yellow oxidized earth proves to be of superior bleach.
>
> Although fuller's earth has a true specific gravity about equal to that of other clays, it is so porous in nature that when thoroughly dry most samples will float in water, showing the presence of more than 50 per cent voids.
>
> Chemical analyses have never been regarded as of any particular value in arriving at an interpretation of the possible value of the earth for commercial use. An ultimate analysis, beyond showing the quantity of possibly objectionable impurities as lime and pyrite, is without much meaning. A determination of hydrous silica and of the aluminum silicates, which would in effect constitute the colloidal content, often may be of direct value.
>
> The total silica in different earths may vary from less than 50 per cent to even more than 80 per cent; the alumina is always low, usually from 5 to 20 per cent; the combined water, from 5 to 12 per cent, is about that of the more siliceous clays. These are the more important constituents, and any others may be considered as adulterants, sometimes harmful. Lime and magnesia are nearly always present, and the iron content is usually evidence of secondary enrichment. The alkalies in many of the commercial earths do not total more than 1 per cent. The mechanically carried water (moisture) is high, even more so than in most clays, and there is the same tendency to absorb moisture in storage.
>
> The bleaching power of fuller's earth is the basis of its commercial use. Several theories have been put forward to explain this action. Like many other colloid peculiarities, it is due to a combination of mechanical and electrical properties, with chemical action eliminated from consideration only by nice

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[1] Chem. and Met. Eng., vol. 26, No. 13, p. 602, March 29, 1922.

[2] Maynard, T. P., and Mallory, L. E., Commercial preparation and use of fuller's earth: Chem. and Met. Eng., vol. 26, No. 23, pp. 1074–1076, June 7, 1922.

differentiation. It is a combination of adsorption and mechanical filtration, accompanied by some chemical disintegration due to selective adsorption.

The active constituents of the earth are probably hydrous silica and hydrous aluminum silicates. The porous nature of the earth, due to the fact that it is built up of grains approaching colloidal size, offers a large active surface.

The driving off of the combined water does not directly affect the bleaching properties of the earth, but this may require temperatures that will destroy a portion of this power by a reduction in surface as the clinkering stage is reached. Coarsely ground earths used in the bleaching of petroleum oils are not affected in their bleaching properties when the water of combination is driven off, while the very finely divided earths used in the bleaching of vegetable oils have their bleach more materially injured by driving off the combined water.

A few earths can be used for bleaching both mineral and vegetable oils, while most of the earths are by nature limited to one field or the other. In the bleaching of mineral oils an earth of high specific volume is more in demand, while in the refining of vegetable oils earths of lower specific volume are more desirable.

The methods of preparation of earth for the bleaching of mineral oils and vegetable oils are quite different. The preparation of the earth for the bleaching of mineral oils is much nearer standardization.

The earth is graded by size of particles for bleaching mineral oils according to the nature of the oil to be treated. The more common gradings are 30 to 60 and 60 to 80 mesh, while there is some demand for 15 to 30 and minus 80 mesh. The earth is burned at a low heat to remove moisture and combined water and then placed in large cylindrical containers. The oil is percolated through under pressure, if necessary. When the oil runs too dark the earth is washed as free of oil as practicable and burned in rotary kilns. The number of times an earth may be reused depends mostly upon the resistance that it shows to breaking down in burning and handling; with 25 to 30 per cent loss the earth is reused as much as 10 times. The quantity of oil bleached by a ton of earth, of course, varies widely; with medium oils a total of 250 barrels per ton of earth is good practice.

In the refining of vegetable oils the crude oil is heated and treated with an alkali to remove the fatty acids and convert the coloring matter to the basic form. The oil is usually bleached at approaching the boiling point of water by stirring in from 1 to 5 per cent of the earth. Moisture, either in the earth or in the oil, interferes with the process. The hot oil, with the fuller's earth in suspension, is then forced through a filter press. Following this the oil is put through a deodorizing process. The refining then varies, depending on the use to which the oil is to be put and upon the particular process of manufacture. Some processes include a second bleaching with a mixture of fuller's earth and carbon black. The oil usually starts the bleach with slightly alkaline reaction and finishes the process somewhat acid.

The amount of earth used, from 1 to 5 per cent, is determined by laboratory control for the bleach required. The filter cake is usually washed with steam, hot water, air, or various combinations of these. The cake is then wasted with any retained oil. As the earth tends to oxidize the oil, the cake must regularly and carefully be disposed of. Some earths can not be used, as they oxidize the oil so rapidly that it takes fire in the presses.

The earth is prepared by drying and grinding 70 to 100 per cent through 200 mesh for the vegetable oil bleach. This fineness of grinding depends, or should depend, upon the producer's understanding of the individual characteristics of his earth. A finely porous earth requires less grinding to develop the necessary bleaching surface. The grinding is further limited by the behavior of the earth in the bleaching kettles, in the pumps, and in the filter presses. Furthermore, each earth possesses a natural limit in bleach beyond which it requires much more than a relative increase in bleaching surface, whether by finer grinding or an increased percentage of earth, to obtain another point or two in bleach. A little calculation makes this understandable. One pound of commercial fuller's earth offers a bleaching surface of several hundred square feet. Six per cent of this earth thoroughly stirred through the oil gives an oil film thin enough to compare closely with recently determined films of lubricating oils. The effectiveness of the earth at this concentration should be rapidly approaching a limit.

Fuller's earth found its first commercial use in removing oil from woolen cloth. This property of absorbing oil is inherent in the earth. * * * Oil losses in filtering vegetable oils run from 15 per cent of the weight of the earth used to more than 30 per cent. At the lower figure they exceed in cost the value of the fuller's earth. The refiner endeavors to reduce the losses of oil by scouring the cake and experimenting to find commercial means of recovery. The producer can bring his brand of earth into favor by lowering the oil losses with his earth as much as is practicable.

These losses may be divided into three more or less determinate parts—(1) loss in oil film, (2) loss by absorption in the pores of the earth, (3) loss in small and inaccessible voids between the particles.

In a well-washed cake the loss in oil film should not amount to more than 10 per cent of the total loss; the loss by absorption of pores in the earth is a property of the individual earth, though it can often be lessened by proper grinding; the third and often largest factor can be regulated more directly, although a separate problem for each type of earth. The use of the best adapted system of grinding or the proper combination of two or more systems of grinding makes possible the grading of particles that will reduce these inaccessible voids in the cake to a minimum, while in no way interfering with the filtering properties of the earth.

The authors have recently put through a wide series of commercial tests on certain earths with oil losses markedly lower than with other earths and with bleaching properties superior to those of the standard English earth.

* * * * * * *

There is a possibility of a widening market in making cheap "clay pigments" due to the property of fuller's earth of strongly adsorbing basic dyes. The property of adsorbing bases gives it a real value as a commercial and simple water "softener." The earth when freed of sand and properly ground is in good standing as a filler, particularly in the rubber trade. The "fines" now wasted in the preparation of the earths for the mineral-oil trades may be utilized by further preparation for the uses above mentioned.

Carbon blacks, calcined bauxite, prepared lignite, and infusorial earth are also used in the refining of oils and sirups. It is possible that fuller's earth under modifications of present processes, where necessary and practical, may replace some of these materials.

In arriving at the possible value of an undeveloped earth a geological interpretation of its origin is of primary importance. Determination by chemical analysis of hydrous silica and aluminum silicates may have scientific value in predicting bleaching quality.

A relative determination of bleaching surface due to porosity may be made by comparing the bleaching power of an earth at different finenesses. This may be used as a base to determine nature of grinding required not only to develop bleach but also to control oil absorption.

Commercially feasible developments are dependent on location with respect to transportation, inherent superior qualities of the earth, preparation that develops these natural advantages for a particular market, and then technical control of the product. Only by a combination of these essentials can a reliable, uniform, dependable, superior commercial earth be prepared.

Our investigations show that while American earths of superior bleach to standard English earth are on the market, yet the excessive oil retention of these earths resulting from a lack of proper grinding and technical control have prevented them from occupying the position they should have.

Earths of dependable uniformity are available and eminently satisfactory to the mineral-oil refineries. However, the large amount of "fines" resulting from grinding and which can not be used by this trade, and which materials are now largely wasted, can be utilized and established in other trades by their proper preparation, at values equal to the earth shipped to the oil refineries. The present losses are wasteful and inexcusable.

While the markets and the value of fuller's earth have been growing rapidly, the producer of the mineral-oil [bleach] on the one hand has paid little attention to his by-product in the way of "fines" and the producer of the vegetable-oil bleach on the other hand has not developed the all-around desirable earth that his market demands.

With the growing knowledge of the needs of the industries, technical control of production is the next step in development and will lead to markets otherwise beyond attainment or even conception.

HISTORY

Fuller's earth was first discovered in the United States in 1891 near Alexander, Ark., by John Olsen. This earth was used for a time by the Southern Cotton Oil Co., at Little Rock, Ark., but its use was finally abandoned.[3] The real beginning of the industry in this country was, however, in 1893 near Quincy, Fla., when quite by accident, in an unsuccessful effort to burn brick on the property of the Owl Cigar Co., an employee called attention to the close resemblance between the clay used and the German fuller's earth. This discovery in Florida caused considerable excitement, and deposits of fuller's earth were reported from a number of States, but the material in most of these deposits was found to have no value as fuller's earth. Production began in Florida almost immediately after the discovery, and in 1897–1899 fuller's earth was produced in Florida, Colorado, New York, and Utah, with Florida the leading producer, a rank that it has maintained continuously. In 1901 Arkansas again became a producer. From 1904 to 1907 Arkansas was the second largest producer. Fuller's earth was found in Georgia soon after its discovery in Florida, but Georgia did not become a producer until 1907, when it was the third largest producing State, and it has ranked second since 1909, except in 1918 and 1919, when Texas was second. In 1904 Alabama and Massachusetts, in 1907 South Carolina and Texas, in 1909 California, in 1918 Nevada, and in 1922 Illinois and Pennsylvania first appeared as producers.

PRODUCTION

Domestic fuller's earth sold in 1916–1923

Year	Operators reporting sales	Short tons	Value at mines	
			Total	Average
1916	10	67, 822	$706, 951	$10. 42
1917	11	72, 567	772, 087	10. 64
1918	14	84, 468	1, 146, 354	13. 57
1919	10	106, 145	1, 998, 829	18. 83
1920	12	128, 487	2, 506, 189	19. 51
1921	12	105, 609	1, 973, 848	18. 69
1922	15	138, 944	2, 289, 719	16. 48
1923	15	149, 134	2, 247, 523	15. 07

The small number of producers in some States makes it impossible to publish totals for those States without disclosing individual operations. Nearly all the earth produced in 1923 came from the Southern States. Two operators reported in Illinois, and one reported in Massachusetts. Florida was the leading State, Georgia was second, and Texas was third, as for a number of years. These three States reported 92 per cent of the output in 1923, compared with 97 per cent in 1922. Illinois was fourth, Massachusetts fifth, and Alabama sixth. The outstanding features of the industry in 1923 were the decrease in production in Florida and Georgia and the increase in production in Illinois, by the addition of a new plant, and in Texas.

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[3] Branner, J. C., An early discovery of fuller's earth in Arkansas: Am. Inst. Min. Eng. Trans., vol. 43, pp. 520–522, 1913.

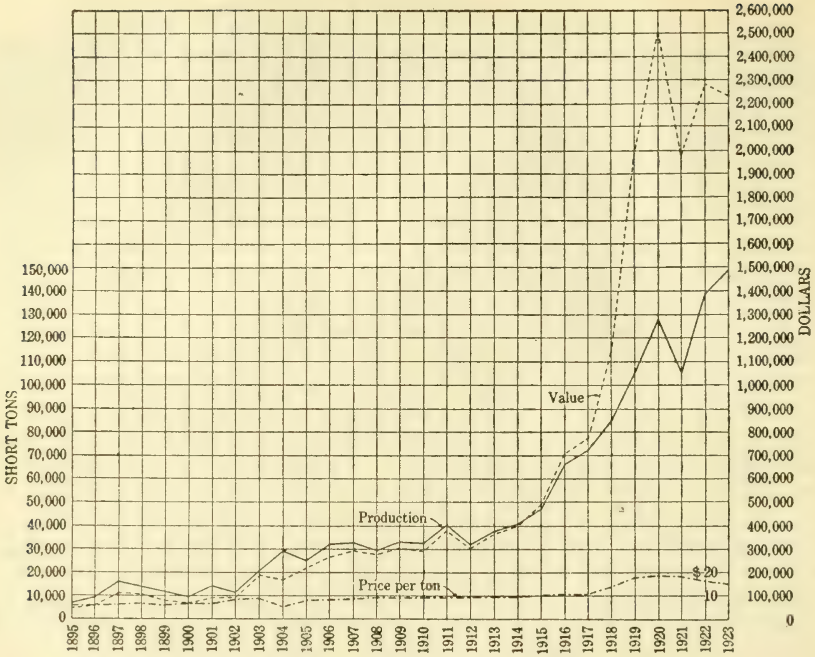

FIGURE 8.—Production, total value, and average value per ton of fuller's earth, 1895–1923.

IMPORTS

The imports of fuller's earth, which at one time constituted the entire supply, were increasing before the World War and reached their maximum in 1914. Since 1914, except in 1917, 1920, and 1922, there has been a steady decline in imports, the quantity in 1923 being the lowest in more than 25 years. Owing, however, to the higher prices prevailing in later years the value of the imports in 1923 was not so low comparatively but was the lowest since 1909. Wrought or manufactured earth represented in 1923 about 93 per cent of the quantity and value of imports.

Fuller's earth imported and entered for consumption in the United States, 1917–1923

Year	Unwrought or unmanufactured			Wrought or manufactured			Total		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average		Total	Average		Total	Average
1917	1,441	$11,718	$8.13	15,553	$164,699	$10.59	16,994	$176,417	$10.38
1918	1,085	12,636	11.65	15,837	213,599	13.49	16,922	226,235	13.37
1919	373	4,301	11.53	13,500	185,410	13.73	13,873	189,711	13.67
1920	1,518	19,793	13.04	17,497	202,100	11.55	19,015	221,893	11.67
1921	483	6,172	12.78	9,261	113,243	12.23	9,744	119,415	12.26
1922	607	7,413	12.21	9,962	128,282	12.88	10,569	135,695	12.84
1923	642	8,252	12.85	7,905	105,692	13.37	8,547	113,944	13.33

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MINERAL WATERS

By W. D. Collins[1]

SCOPE OF REPORT

The term "mineral water" as here used applies to water that is bottled and sold in its natural state or only slightly altered from its natural state. It includes (*a*) natural carbonated waters that have lost part of their carbon dioxide; (*b*) natural waters that have been artificially carbonated; and (*c*) waters from which iron has been removed. It does not include artificial waters or natural waters that have been essentially modified in chemical character.

The statistics in this report refer only to mineral waters that have been sold. Water that is given away, including water furnished free for drinking or bathing to guests at hotels or to patients at sanitariums, has been omitted, even where data are available to show the quantity of water so used. Hence, as actual sales fall far short of the total quantity used, particularly of such waters as are drunk at resorts for their medicinal value, the totals do not represent the full magnitude of the trade.

Three uses of mineral waters are recognized in this report—table use, medicinal use, and use in manufacture of soft drinks—but the quantity and value of water used in the manufacture of soft drinks are not included in the totals. In former reports the springs whose waters were used only for making soft drinks were included in the number of producing springs. In this report such springs are excluded from the following table and enumerated separately on page 111.

The distinction for statistical purposes between table and medicinal waters is entirely arbitrary and is based on the reports furnished by the owners and operators of springs stating the uses for which the waters are sold.

The list of springs and wells on pages 115–124 includes all for which reports of sales of water in 1923 were received and some whose waters were reported to be used only in the manufacture of soft drinks.

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[1] The statistics showing production were compiled by Mrs. E. R. Phillips, of the United States Geological Survey. Those showing imports and exports were compiled by J. A. Dorsey from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Domestic mineral waters sold in the United States in 1922 and 1923, by States

State	1922			1923			Percentage of increase or decrease	
	Commercial springs	Gallons	Value	Commercial springs	Gallons	Value	Quantity	Value
Alabama	4	5, 389	$875	4	4, 878	$763	−9	−13
Arkansas	5	248, 460	28, 866	7	723, 341	60, 119	+191	+108
California	29	3, 048, 324	433, 711	33	7, 275, 735	664, 621	+139	+53
Colorado	9	146, 626	55, 283	8	171, 089	55, 072	+17	−.4
Connecticut	18	1, 141, 421	70, 926	17	1, 077, 195	63, 732	−6	−10
Florida	9	1, 004, 984	57, 305	18	1, 697, 197	131, 781	+69	+130
Georgia	8	424, 290	36, 856	11	637, 907	58, 810	+50	+60
Illinois	7	335, 974	18, 679	7	390, 578	14, 648	+16	−22
Indiana	7	514, 211	156, 358	7	500, 064	152, 082	−3	−3
Iowa	3	25, 561	3, 788	3	45, 072	8, 907	+76	+135
Kansas	8	383, 600	64, 554	12	494, 048	77, 935	+29	+21
Kentucky	8	191, 275	30, 430	10	210, 367	33, 050	+10	+9
Louisiana	2	([a])	([a])	2	([a])	([a])	--------	--------
Maine	20	928, 149	368, 939	20	973, 442	415, 353	+5	+13
Maryland	8	749, 624	73, 890	10	874, 689	88. 568	+17	+20
Massachusetts	26	1, 417, 111	81, 674	29	1, 958, 556	110, 305	+38	+35
Michigan	9	1, 229, 802	150, 237	9	1, 478, 135	164, 968	+20	+10
Minnesota	10	2, 962, 160	156, 066	12	1, 806, 292	136, 855	−39	−12
Mississippi	5	100, 548	25, 966	4	93, 441	23, 379	−7	−10
Missouri	24	141, 369	40, 149	27	174, 636	38, 145	+24	−5
Montana	2	([a])	([a])	2	([a])	([a])	--------	--------
Nebraska	--------	--------	--------	1	([a])	([a])	--------	--------
Nevada	1	([a])	([a])	1	([a])	([a])	--------	--------
New Hampshire	2	([a])	([a])	3	156, 607	12, 642	--------	--------
New Jersey	8	290, 808	30, 800	13	507, 680	50, 261	+75	+63
New Mexico	2	([a])	([a])	3	2, 125	643	--------	--------
New York	37	6, 965, 638	800, 831	41	6, 716, 154	803, 433	−4	+.3
North Carolina	5	65, 020	9, 941	6	74, 745	7, 840	+15	−21
North Dakota	2	([a])	([a])	1	([a])	([a])	--------	--------
Ohio	20	2, 298, 132	162, 814	20	2, 693, 541	182, 604	+17	+12
Oklahoma	10	1, 434, 885	46, 047	10	996, 564	34, 562	−31	−25
Oregon	3	2, 621	598	3	3, 058	588	+17	−2
Pennsylvania	23	824, 988	81, 435	22	807, 522	84, 945	−2	+4
Rhode Island	6	279, 109	25, 704	6	277, 945	26, 211	−.4	+2
South Carolina	5	96, 900	21, 622	5	121, 576	25, 078	+25	+16
South Dakota	3	796, 500	32, 850	3	780, 500	29, 610	−2	−10
Tennessee	13	1, 005, 119	67, 838	13	649, 348	41, 737	−35	−38
Texas	10	307, 478	50, 737	9	347, 973	61, 231	+13	+21
Vermont	2	([a])	([a])	2	([a])	([a])	--------	--------
Virginia	30	840, 113	111, 879	29	836, 709	104, 680	−.4	−6
Washington	2	([a])	([a])	4	124, 273	11, 883	--------	--------
West Virginia	5	380, 726	32, 137	7	478, 520	70, 447	+26	+119
Wisconsin	21	6, 126, 143	2, 120, 669	18	6, 977, 448	2, 612, 452	+14	+23
Wyoming	2	([a])	([a])	2	([a])	([a])	--------	--------
Undistributed [b]	--------	1, 779, 823	47, 815	--------	1, 292, 048	33, 237	--------	--------
	433	38, 492, 881	5, 498, 269	474	44, 430, 998	6, 493, 177	+15	+18

[a] Included under "Undistributed."

[b] 1922: Louisiana, Montana, Nevada, New Hampshire, New Mexico, North Dakota, Vermont, Washington, and Wyoming; 1923: Louisiana, Montana, Nebraska, Nevada, North Dakota, Vermont, and Wyoming.

Value of medicinal and table waters sold in the United States in 1923

State	Medicinal waters	Table waters	Total	State	Medicinal waters	Table waters	Total
Arkansas	$50, 017	$10, 102	$60, 119	New Jersey	$1, 277	$48, 984	$50, 261
California	104, 125	560, 496	664, 621	New York	63, 858	739, 575	803, 433
Colorado	3, 454	51, 618	55, 072	North Carolina	2, 407	5, 433	7, 840
Florida	15, 773	116, 008	131, 781	Ohio	5, 506	177, 098	182, 604
Georgia	1, 935	56, 875	58, 810	Oklahoma	1, 300	33, 262	34, 562
Illinois	438	14, 210	14, 648	Pennsylvania	7, 388	77, 557	84, 945
Indiana	127, 357	24, 725	152, 082	Rhode Island	--------	26, 211	26, 211
Kansas	47, 503	30, 432	77, 935	South Dakota	--------	29, 610	29, 610
Kentucky	22, 720	10, 330	33, 050	Tennessee	9, 624	32, 113	41, 737
Maine	108, 724	306, 629	415, 353	Virginia	79, 062	25, 618	104, 680
Maryland	--------	88, 568	88, 568	West Virginia	34, 656	35, 791	70, 447
Minnesota	8, 913	127, 942	136, 855	Wisconsin	17, 573	2, 594, 879	2, 612, 452
Mississippi	23, 379	--------	23, 379	Undistributed [a]	99, 376	381, 959	481, 335
Missouri	32, 634	5, 511	38, 145				
New Hampshire	--------	12, 642	12, 642		868, 999	5, 624, 178	6, 493, 177

[a] Alabama, Connecticut, Iowa, Louisiana, Massachusetts, Michigan, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Carolina, Texas, Vermont, Washington, and Wyoming.

SOFT DRINKS

Mineral waters used in the manufacture of soft drinks in 1923

State	Number of springs			Gallons
	Soft drinks only	Soft drinks and table or medicinal waters	Total	
California	1	6	7	639, 828
Colorado		3	3	81, 600
Connecticut	4	4	8	550, 400
Iowa	2	2	4	213, 759
Maine		3	3	103, 794
Massachusetts	5	7	12	1, 570, 026
Michigan		5	5	145, 654
Minnesota		7	7	294, 413
New Hampshire		3	3	947, 406
New Jersey	1	3	4	48, 656
New York		6	6	91, 073
Pennsylvania	1	7	8	496, 193
Rhode Island		4	4	137, 020
Virginia		3	3	59, 000
Wisconsin	4	10	14	1, 048, 716
Other States [a]	2	22	24	871, 525
	20	95	115	7, 299, 063

[a] Arkansas, Florida, Illinois, Kansas, Kentucky, Louisiana, Maryland, Missouri, Nebraska, New Mexico, Ohio, Oklahoma, Oregon, South Carolina, South Dakota, Washington, West Virginia, and Wyoming.

IMPORTS AND EXPORTS

Mineral waters imported for consumption in the United States, 1919–1923

Year	Gallons	Value	
		Total	Average (cents)
1919 [a]	193, 933	$112, 732	58
1920 [a]	466, 547	177, 992	38
1921 [a]	498, 090	156, 297	31
1922	698, 751	269, 245	39
1923	722, 657	279, 875	39

[a] Natural mineral waters exclusively. Figures for 1922 and 1923 include artificial mineral waters and imitation mineral waters, in addition to natural mineral waters, not separately classified after 1921.

Mineral waters (artificial and natural) imported into the United States in 1923, by countries

[General imports]

Country	Gallons	Value	Country	Gallons	Value
Belgium	7, 668	$4, 776	Italy	170, 144	$69, 340
Brazil	15	27	Japan	2, 973	2, 617
Canada	3, 495	6, 412	Netherlands	2, 843	2, 010
Cuba	35	36	Norway	74	115
Czechoslovakia	5, 518	2, 972	Portugal	32	24
England	3, 017	4. 846	Spain	2, 787	3, 282
France	342, 718	132, 468	Sweden	131	27
Germany	253, 568	56, 612	Switzerland	1, 621	1, 085
Greece	349	117			
Honduras	50	12		797, 975	287, 142
Hungary	937	364			

Large quantities of a few domestic waters are exported. No statistics regarding such shipments are available for years prior to 1922. In that year the exports of natural and artificial mineral waters amounted to 209,219 gallons, valued at $169,473. In 1923 the exports were 227,831 gallons, valued at $193,248.

CONDITION OF TRADE

Domestic mineral waters sold in the United States, 1915–1923

Year	Number of commercial springs			Gallons [b]	Value [b]	
	Water sold for table or medicinal use [a]	Water used for soft drinks only	Total		Total	Average (cents)
1915	794	18	812	52, 113, 503	$5, 138, 794	9. 9
1916	784	18	802	55, 928, 461	5, 735, 035	10. 3
1917	697	20	717	46, 784, 419	4, 931, 710	10. 5
1918	553	16	569	40, 709, 722	4, 533, 001	11. 1
1919	501	26	527	38, 697, 280	4, 880, 186	12. 6
1920	456	23	479	36, 218, 260	4, 860, 915	13. 4
1921	434	22	456	34, 781, 238	4, 876, 445	14. 0
1922	433	19	452	38, 492, 881	5, 498, 269	14. 3
1923	474	20	494	44, 430, 998	6, 493, 177	14. 6

[a] Water from some of these springs is used also for soft drinks.
[b] Does not include water used for soft drinks.

The quantity and value of the water sold, which increased appreciably from 1921 to 1922, continued to increase in 1923. The average value per gallon and the average number of gallons sold from a spring also increased. Some of the reported increase in 1923 may be due to special facilities for collection of data in certain States, which made the canvass more thorough than those of former years, but a large part of the increase is definitely known to be due to larger sales from old springs and to sales from springs not producing in 1922.

The industry as a whole is well established and seems likely to continue for a good many years at about its present level. A number of springs with small production will be forced to discontinue, and many of the larger producers will get more business. Some of the producers of table waters may lose much of their business when better public water supplies are furnished in the cities where their sales are largest. The increasing complexity of water-purification processes and increasing pollution of the sources of many public supplies may afford new opportunities for profitable business in furnishing pure, clean, unpolluted water for drinking in offices and homes. Business of this kind requires a considerable investment in equipment for bottling and delivering the water and generally is successful only where it is possible to insure a large volume of regular sales at a moderate price.

Such business as still persists in waters of not unusual composition which are sold as therapeutic agents seems likely to decrease rather than increase. The use of waters that contain medicinal doses of common remedies may increase, and the development of resorts at mineral springs for health and recreation still offers opportunities for profit.

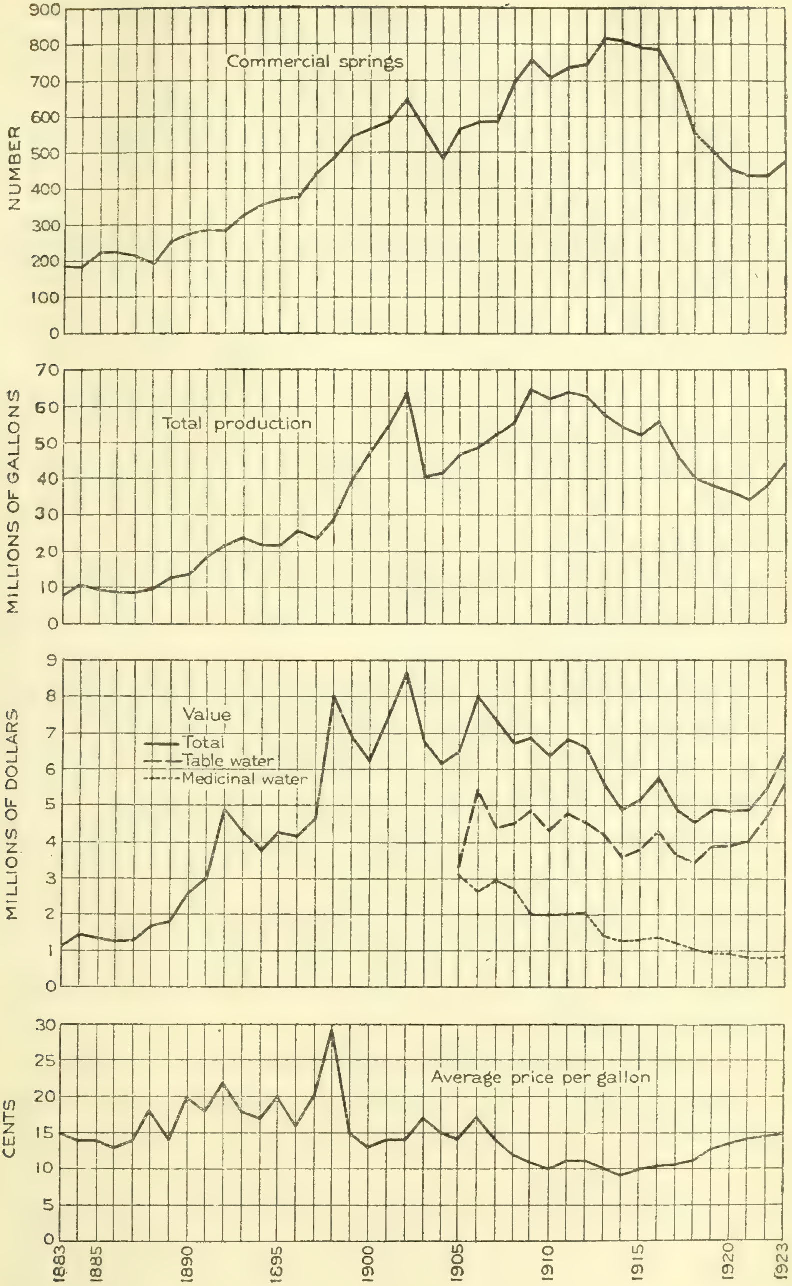

FIGURE 9.—Number of commercial springs, annual production, total value, and average value per gallon of mineral waters in the United States reported from 1883 to 1923

REVIEW OF MINERAL WATER TRADE, 1883-1923

During the 41 years that the Geological Survey has collected statistics on production of mineral waters a radical change has taken place in the mineral-water business. Some features of this change and their causes were discussed in the report on mineral waters for 1914.[1] The fluctuations in number of springs, production, and value for 1883 to 1923 are shown graphically in Figure 9, which is based on the table on page 218 of the report for 1914 and the table on page 112 of the present report. The statistics have not been strictly comparable throughout the period covered, but the general features shown by the graphs would not be altered if it were possible to revise all the reports to a common basis. The results plotted for 1923 include only springs from which sales of water were reported. Before 1913 the number of commercial springs includes a few whose water was used only in the manufacture of soft drinks. Up to the last few years the reports included estimated quantities and values for some springs from which water was known to be sold, although exact figures were not available.

Early reports on production of mineral waters suggest that the waters were sold and used almost entirely as medicinal agents. In the report for 1905, however, a distinction was first made between medicinal waters and table waters, the reports for this year indicating about equal value for the two classes. As the medicinal waters have in general been sold at much higher prices than table waters, the volume of table water sold in 1905 must have been much greater than the volume of medicinal water.

Reports of companies operating in a number of cities showed increasing sales of table waters during periods while the public water supply was unsafe or was objectionable on account of turbidity, color, or odor. When these conditions were remedied by the adoption of filtration or by obtaining a better supply from another source, the sales of mineral water in these cities practically stopped. Part of the recent increase in sales of table waters may be due to the tastes and odors which have at times characterized some perfectly safe waters from public supplies.

In 1923 the sales of medicinal waters represent only about 13 per cent of the total value and a much smaller proportion of the total quantity. The mineral-water trade is now largely in waters that are sold in their natural state or carbonated as pure, wholesome drinking water for offices and homes.

SOURCES OF MINERAL WATERS SOLD IN 1923

The following list gives the name and location of each spring or well from which sales of water were reported for 1923 and of some whose waters were used only in the manufacture of soft drinks. Most of the bathing and hotel accommodations noted are in establishments conducted by the owners of the springs, and the statements made are those given in the reports made by the owners. The list is far from complete as regards bathing establishments and hotels maintained in connection with mineral springs, because it includes only the names of springs from which water was sold or was used for making soft drinks.

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[1] Dole, R. B., The production of mineral waters in 1914, with a historical sketch of the mineral-water trade: U. S. Geol. Survey Mineral Resources, 1914, pt. 2, pp. 175-219, 1915.

Springs or wells from which mineral waters were sold in 1923, by States

Alabama

Spring or well	Location		Bathing establishment (B) and hotel (H), with capacity (number of guests)
	Nearest post office	County	
Healing Springs	Healing Springs	Washington	H (70).
Matchless Mineral Wells	Greenville	Butler	
Shocco Springs	Talladega	Talladaga	H (35).
White Sulphur Wells	Jackson	Clarke	B, H (100).

Arkansas

Arsenic Spring	Hot Springs	Garland	(a)
De Soto Spring	do	do	(a)
Happy Hollow Springs	do	do	(a)
Mountain Valley Spring	Mountain Valley	do	H (35).
Ozarka Nos. 1, 2, and 3	Eureka Springs	Carroll	
Raleigh Springs	Little Rock	Pulaski	
Sulphur Magnesia	Hot Springs	Garland	

California

Albion Spring	San Francisco	San Francisco	
Alhambra Springs	Martinez	Contra Costa	
Alma Spring	Alma	Santa Clara	
Arrowhead Springs	Arrowhead Springs	San Bernardino	B, H.[b]
Barcal Mineral Spring	Preston	Sonoma	
Bartlett Spring	Bartlett Springs	Lake	B, H (500).
Beulah Springs	Arlington	Riverside	
Bimini Hot Springs	Los Angeles	Los Angeles	B.
Busch Springs	Potter Valley	Mendocino	
Crystal Springs	Los Angeles	Los Angeles	
El Granito Mineral Spring	El Cajon	San Diego	
Elysian Springs	Los Angeles	Los Angeles	
Grizzly Springs	Williams	Lake	
Holly Springs	Hollywood	Los Angeles	
Iaqua Medicinal Springs	Eureka	Humboldt	
Lepori Vichy Springs	Napa	Napa	
Melrose Mineral Spring	Los Angeles	Los Angeles	B.
Mok-Hill Mineral Spring	Mokelumne Hill	Calaveras	
Monterey Mineral Well	Monterey	Monterey	
Mount San Miguel Mineral Spring	National City	San Diego	
Napa Rock Spring	St. Helena	Napa	
Napa Soda Springs	Napa Soda Springs	do	H (250).
Norman Medical Springs	Middletown	Lake	B, H (20).
Polk Springs	Butte Meadows	Tehama	
Richardson Springs	Chico	Butte	B, H (250).
Rock Springs	Escondido	San Diego	
Shanghai Spring	Sausalito	Marin	
Shasta Springs	Shasta Springs	Siskiyou	H (120).
Tamalpais Spring	San Rafael	Marin	
Valley Springs	Valley Springs	Calaveras	
Veronica Springs	Santa Barbara	Santa Barbara	
Vichy Springs	Ukiah	Mendocino	
Walters Springs	St. Helena	Napa	B, H (75).
White Rose Spring	Los Angeles	Los Angeles	

Colorado

Boulder Springs and Lithia Soda Springs	Salina	Boulder	
Green Mineral Well	Canon City	Fremont	
Horn Mineral Spring	Colorado Springs	El Paso	
Navajo, Shoshone, and Cheyenne springs	Manitou	do	
Pueblo Mineral Spring	Pueblo	Pueblo	
Ute, Ouray, and Little Chief Iron springs	Manitou	El Paso	
Waunita Hot Radium Springs	Waunita Hot Springs	Gunnison	B, H (200).
Yampah Spring	Glenwood Springs	Garfield	B, H (600).

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[a] Large bathing establishments and hotels maintained at Hot Springs by private persons use water from the springs, which are under Government control.

[b] Used by the United States Government.

Springs or wells from which mineral waters were sold in 1923, by States—Continued

Connecticut

Spring or well	Location		Bathing establishment (B) and hotel (H), with capacity (number of guests)
	Nearest post office	County	
Althea Spring	Waterbury	New Haven	
Bailey Natural Spring	Danbury	Fairfield	
Camp Meeting Spring	Milford	New Haven	
Cherry Hill Spring	Highwood	do	
Crystal Spring	Middletown	Middlesex	
Crystal Spring	Derby	New Haven	
East Hill Spring	Ansonia	do	
Elco Springs	Bristol	Hartford	
Granite Rock Spring	Haddam	Middlesex	
Gra Rock Spring	Canton	Hartford	
Hillside Spring	Meriden	New Haven	
Hosmer Mountain Spring	Windham	Windham	
Live Oak Spring	Meriden	New Haven	
Luippold's Mineral Spring	Bridgeport	Fairfield	
Pequot Spring	Glastonbury	Hartford	
Richardson Spring	Torrington	Litchfield	
Rockledge Spring	New Haven	New Haven	
Rock Spring	Fairfield	Fairfield	
Silver Rock Spring	Middletown	Middlesex	
Stafford Springs	Stafford	Tolland	
Varuna Spring	Stamford	Fairfield	

Florida

Bracks Get Well Spring	Bradentown	Manatee	
Crystal Mineral Spring	White House	Duval	
Crystal Springs	Crystal Springs	Pasco	
Deep Rock Spring	West Palm Beach	Palm Beach	
Egret Springs	Fort Pierce	St. Lucie	
Espiritu Santo Springs	Safety Harbor	Pinellas	B, H (75).
Flamingo Spring	Orange City	Volusia	
Good Hope Mineral Spring	Jacksonville	Duval	
Gra Rock Well	Miami	Dade	
Hampton Springs	Hampton Springs	Taylor	B, H (90).
Heilbronn Spring	Starke	Bradford	
Peerless Spring	Miami	Dade	
Pipkins Mineral Well	Safety Harbor	Pinellas	B, H (60)
Purity Spring	Tampa	Hillsborough	
Saint Nicholas Mineral Springs	South Jacksonville	Duval	
Su-no-wa Spring	Bryceville	Nassau	
White Springs	White Springs	Hamilton	
Wi-Wauchula Spring	Jacksonville	Duval	

Georgia

Benscot Mineral Springs	Austell	Cobb	
Bowden Springs	Lithia Springs	Douglas	
Cascade Spring	Atlanta	Fulton	
Catoosa Springs	Tunnel Hill	Catoosa	
Cliff Rock Springs	Atlanta	Fulton	
Daniel Mineral Spring	Union Point	Greene	
Eureka Springs	Eureka Springs	Dodge	B, H (200).
Fender Spring	Augusta	Richmond	
High Rock Spring	Atlanta	Fulton	
White Oak Wells	Macon	Bibb	
Windsor Spring	Augusta	Richmond	

Illinois

Abana Mineral Spring	Libertyville	Lake	
Gravel Springs	Jacksonville	Morgan	
Montgomery Magnesia Spring	Montgomery	Kane	
Na-mo-no-ma Spring	Dixon Springs	Pope	B, H (60).
Old Ironsides	do	do	B, H (60).
Ripley Mineral Springs	Ripley	Brown	
Sanicula Mineral Springs	Ottawa	La Salle	B.

Springs or wells from which mineral waters were sold in 1923, by States—Continued

Indiana

Spring or well	Location		Bathing establishment (B) and hotel (H), with capacity (number of guests)
	Nearest post office	County	
Carlson's Mineral Springs	Laporte	Laporte	
Cartersburg Mineral Springs	Cartersburg	Hendricks	
Greenwood Springs	Fort Wayne	Allen	
Holman Mineral Well	Crawfordsville	Montgomery	
Mount Jackson Mineral Well	Indianapolis	Marion	B.
Pluto, Proserpine, and Bowles springs	French Lick	Orange	B, H (800).
White Crane Well	Dillsboro	Dearborn	B, H (145).

Iowa

Colfax Mineral Spring	Colfax	Jasper	
Fry's Well	do	do	
Grand Hotel Mineral Spring	do	do	B, H (68).
Hygeia Well	Sioux City	Woodbury	
Lime Rock Springs	Dubuque	Dubuque	

Kansas

Abilena Wells	Abilene	Dickinson	
Blasing's Springs	Manhattan	Riley	B, H (10).
Conway Springs	Conway Springs	Butler	
Crystal Springs	Coffeyville	Montgomery	
Geuda Springs	Geuda Springs	Cowley	
Mineral Rock Springs	Kansas City	Wyandotte	
Mission Springs	Mission	Harvey	
Rockheart Mineral Spring	Parsons	Labette	
Sunnydale Springs	Valley Center	Sedgwick	
Sycamore Springs	Morrill	Brown	
Viola Springs	Viola	Sedgwick	
Waconda Springs	Waconda Springs	Mitchell	B, H (70).

Kentucky

Anita Springs	La Grange	Oldham	
Avonmore Hotel Spring	Dry Ridge	Grant	
Cole's Lithia Springs	Lexington	Fayette	
Glen Lily Springs	Bowling Green	Warren	
Hamby's Genuine Dawson Springs	Dawsonsprings	Hopkins	(c)
H. & H. Well	do	do	(c)
Kentucky Carlsbad Springs	Dry Ridge	Grant	B, H (68).
Phillips Well	Dawsonsprings	Hopkins	B. [c]
Robson Springs	Fort Thomas	Campbell	
Stevens Well	Dawsonsprings	Hopkins	(c)

Louisiana

Krotz Springs	Krotz Springs	St. Landry Parish	
Ozone Spring	Pearl River	St. Tammany Parish.	

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[c] Town of Dawsonsprings accommodates 2,000.

Springs or wells from which mineral waters were sold in 1923, by States—Continued

Maine

Spring or well	Location		Bathing establishment (B) and hotel (H), with capacity (number of guests)
	Nearest post office	County	
Baker Puritan Spring	Old Orchard	York	
Crystal Spring	Skowhegan	Somerset	
Glenrock Cold Spring	Greene	Androscoggin	
Glenwood Spring	Augusta	Kennebec	
Hanover Spring	Hanover	Oxford	
Highland Spring	Lewiston	Androscoggin	
Holbrook Hill Spring	Pittsfield	Somerset	
Indian Hermit Mineral Spring	Wells	York	
Keystone Mineral Spring	Poland	Androscoggin	
Mount Desert Spring	Mount Desert	Hancock	H (700).
Mount Kebo Spring	Bar Harbor	do	
Mount Zircon Spring	Rumford	Oxford	
Mystic Spring	Saco	York	
Oak Grove Spring	Brewer	Penobscot	
Paradise Spring	Brunswick	Cumberland	
Pine Spring	Topsham	Sagadahoc	
Poland Mineral Spring	Poland	Androscoggin	H (650).
Rocky Hill Spring	Fairfield	Somerset	
Thorndike Mineral Spring	Thorndike	Waldo	
Wawa Lithia Spring	Wells	York	
Maryland			
Big Rock Spring	Thurmont	Frederick	
Brooklandwood Spring	Brooklandville	Baltimore	
Buena Vista Spring	Edgemont	Washington	
Caton Spring	Catonsville	Baltimore	
Chattolanee Springs	Garrison	do	
Conoy Spring	Branchville	Prince Georges	
Gray Rock Spring	Woodlawn	Baltimore	
Green Spring	Big Spring	Washington	
Hygeia Crystal Springs	Annapolis	Anne Arundel	
Rock Spring	Gapland	Washington	
Massachusetts			
Abbott Spring	Methuen	Essex	
Blue Hill Spring	Milton	Norfolk	
Burnham Spring	Methuen	Essex	
Cascella Springs	Three Rivers	Hampden	
Chapman's Crystal Spring	Stoneham	Middlesex	
Chelmsford Spring	Chelmsford	do	
Crystal Spring	West Peabody	Essex	
El-Azhar Spring	Tyngsboro	Middlesex	
Emmons Spring	Lawrence	Essex	
Goulding Spring	Whitman	Plymouth	
Hamilton Mineral Spring	Framingham	Middlesex	
King Philip Spring	Mattapoisett	Plymouth	
Klines Spring	Lawrence	Essex	
Leicester Polar Springs	Leicester	Worcester	
Monatiquot Spring	South Braintree	Norfolk	
Mount Blue Mineral Spring	Hingham	Plymouth	
Mount Holyoke Spring	South Hadley	Hampshire	
Mount Pleasant Spring	Lowell	Middlesex	
Nemasket Mineral Spring	Middleboro	Plymouth	
Norwood Spring	Norwood	Norfolk	
October Spring	Lenox	Berkshire	
Old Homestead Springs	Lawrence	Essex	
Peerless Spring	Lynn	do	
Pepperell Spring	Pepperell	Middlesex	
Pilgrim Springs	Marshfield	Plymouth	
Pocahontas Spring	Lynnfield	Essex	
Powato Well	Wareham	Plymouth	
Purity Spring	Danvers	Essex	
Purity Spring	Lowell	Middlesex	
Robbins Spring	Arlington	do	
Sand Springs	Williamstown	Berkshire	B. H (30).
Shawmut Spring	Quincy	Norfolk	
Simpson Spring	South Easton	Bristol	
Sterling Spring	Lynn	Essex	

Springs or wells from which mineral waters were sold in 1923, by States—Continued

Michigan

Spring or well	Location		Bathing establishment (B) and hotel (H), with capacity (number of guests)
	Nearest post office	County	
Andrews Magnetic Mineral Spring	St. Louis	Gratiot	B, H (200).
Arctic Spring	Grand Rapids	Kent	
Eastman Springs	Benton Harbor	Berrien	H (21).
John Gerick Farm Spring	Denton	Wayne	
Maple Leaf Spring	Mount Clemens	Macomb	
Panacea Spring	do	do	
Ponce de Leon Spring	Grand Rapids	Kent	
Silver Springs	Northville	Wayne	
Victory Springs	Mount Clemens	Macomb	

Minnesota

Blue Spruce Farm Spring	Hanley Falls	Yellow Medicine	
Clear Spring	Hopkins	Hennepin	
Conedale Spring	Winona	Winona	
Deep Spring	Crookston	Polk	
Glen Springs	Excelsior	Hennepin	
Glenwood Inglewood Spring	Minneapolis	do	
Highland Spring	St. Paul	Ramsey	
Pokegama Springs	Detroit	Becker	
Red Star Spring	Cold Spring	Stearns	
Rock Spring	Shakopee	Scott	
Silver Springs	Marshall	Lyon	
Ward Springs	Ward Springs	Todd	B, H (84)

Mississippi

Allisons Well	Way	Madison	B, H (150).
Browns Wells	Hazlehurst	Copiah	H (300).
Robinson Springs	Pocahontas	Hinds	
Stafford Mineral Spring	Vosburg	Jasper	H (80).

Missouri

Aperient Well	Eldorado Springs	Cedar	
B. B. Springs	Bowling Green	Pike	B, H (50).
Belcher Artesian Well	St. Louis	St. Louis	B, H (300).
Bokert Springs	De Soto	Jefferson	
Chalybeate Springs	Paris Springs	Lawrence	
Chouteau Springs	Boonville	Cooper	B, H (25).
Claymount Spring	Randolph	Clay	
Crystal Mineral Spring	Excelsior Springs	do	(d)
Crystal Spring	Kansas City	Jackson	
Cusenbary Spring	Mount Washington	do	
Eldorado Laxative Well	Eldorado Springs	Cedar	
Excelsior Saline Well	Excelsior Springs	Clay	(d)
Grand River Mineral Spring	Mercer	Mercer	
Haymaker Springs	Lineville, Iowa	do	
Hornet Springs	Bowling Green	Pike	
Morris Mineral Well	Eldorado Springs	Cedar	
Musick Mineral Well	do	do	
Natrona Spring	Excelsior Springs	Clay	(d)
Old Orchard Mineral Springs	Webster Groves	St. Louis	
Radium Springs	Seligman	Barry	
Regent, Siloam, Sulpho Saline, and Soterian springs.	Excelsior Springs	Clay	(d)
Relief Water Co. Well	do	do	(d)
Saline Soda Well	do	do	(d)
Salt Sulphur Well	do	do	B.[d] [e]
Sweet Spring	Sweet Springs	Saline	

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[d] Town of Excelsior Springs accommodates 5,000.

[e] Furnishes water to six bathhouses.

Springs or wells from which mineral waters were sold in 1923, by States—Continued

Montana

Spring or well	Location		Bathing establishment (B) and hotel (H), with capacity (number of guests)
	Nearest post office	County	
Alhambra Hot Springs	Alhambra	Jefferson	B, H (100).
Lissner Mineral Springs	Helena	Lewis and Clark	

Nebraska

Curo Mineral Springs	Omaha	Douglas	

Nevada

Diamond Mineral Spring	Reno	Washoe	

New Hampshire

Granite State Spring	Plaistow	Rockingham	
Laconia Spring	Laconia	Belknap	
Mount Madison Spring	Gorham	Coos	

New Jersey

Belmar Spring	Ridgewood	Bergen	
Cold Indian Spring	Asbury Park	Monmouth	
Echo Spring	Trenton	Mercer	
Great Rock Spring	Whippany	Morris	
Indian Spring	Rockaway	do	
Indian Lady Hill Springs	Asbury Park	Monmouth	
Mullins Spring	Perth Amboy	Middlesex	
Pine Crest Well	Chatsworth	Burlington	
Rock Spring	West Orange	Essex	
Rosemont Spring	Somerville	Somerset	
Turtle Hill Spring	Passaic	Passaic	
Washington Rock Spring	Plainfield	Somerset	
Watchung Springs	do	do	
XLO Water Well	Cedar Grove	Essex	

New Mexico

Aztec Mineral Springs	Taylor Springs	Colfax	
Faywood Hot Springs	Faywood	Grant	
Ojo Caliente	Ojo Caliente	Taos	

New York

Arlington Spring	Arlington	Dutchess	B.
Baldwin Mineral Spring	Cayuga	Cayuga	
Biochemic Spring	Jamestown	Chautauqua	
Breesport Mineral Spring	Horseheads	Chemung	
Carrier Spring	Potsdam	St. Lawrence	
Cascadian Spring	Grandview	Rockland	
Chemung Springs	Chemung	Chemung	
Chester Crest Spring	Mount Vernon	Westchester	
Clinton Lithia Spring	Kirkland	Oneida	
Crystalate Spring	Whitesboro	do	
Dietade Mineral Spring	Keeseville	Essex	
Eagle Spring	Lanesville	Greene	
Frontenac Crystal Springs	Clayton	Jefferson	H (21).
Glen Alex Springs	Washington Mills	Oneida	
Gramatan Springs	Bronxville	Westchester	
Granite Springs	Granite Springs	do	

Springs or wells from which mineral waters were sold in 1923, by States—Continued

New York—Continued

Spring or well	Location		Bathing establishment (B) and hotel (H), with capacity (number of guests)
	Nearest post office	County	
Great Bear Spring	South Granby	Oswego	
Greendale Crystal Spring	Livingston	Columbia	
Hides Franklin Mineral Spring	Ballston Spa	Saratoga	
Jubilee Spring	Buffalo	Erie	
Mammoth Spring	North Greenbush	Rensselaer	
Mohawk Spring	Amsterdam	Montgomery	
Morgan Spring	Rensselaer	Rensselaer	
Quaker Spring	West Sand Lake	do	
Questover Spring	Moores Mill	Dutchess	
Risley Cold Springs	New York Mills	Oneida	
Sans Souci Spring	Ballston Spa	Saratoga	
Saratoga Vichy and Victoria No. 2 springs	Saratoga Springs	do	(f)
Sparkling Spring	Buffalo	Erie	
Split Rock Lithia Spring	Kirkland	Oneida	
Standard Spring	Troy	Rensselaer	
State Seal, Coesa, Geyser, and Hathorn No. 2 springs.	Saratoga Springs	Saratoga	(f)
Table Rock Mineral Spring	Mendon	Monroe	
Taconic Springs	Beacon	Dutchess	
Trespur Spring	McGraw	Cortland	
White Bear Spring	Stafford	Genesee	
White Sulphur Springs	Sharon Springs	Schoharie	B, H (800).[g]

North Carolina

Spring or well	Nearest post office	County	Bathing establishment (B) and hotel (H), with capacity (number of guests)
Derita Mineral Spring	Derita	Mecklenburg	
Huckleberry Springs	West Durham	Durham	
Moore's Springs	Moores Springs	Stokes	H (250).
Rivermont Carbonated Springs	West Durham	Durham	
Seven Springs	Seven Springs	Wayne	
Shelby Lithia Spring	Shelby	Cleveland	

North Dakota

Spring or well	Nearest post office	County	Bathing establishment (B) and hotel (H), with capacity (number of guests)
Granite Spring	Minot	Ward	

Ohio

Spring or well	Nearest post office	County	Bathing establishment (B) and hotel (H), with capacity (number of guests)
Alba Spring	West Park	Cuyahoga	
Beech Rock Spring	Zanesville	Muskingum	
Cartwright Farm Spring	Parma	Cuyahoga	
Collingwood Springs	Toledo	Lucas	
Crystal Spring	Newark	Licking	
Devonia Mineral Spring	Lorain	Lorain	
Elm Meade Farm Spring	Youngstown	Trumbull	
Fisher's Magnesia Mineral Spring	Columbus	Franklin	
Gibson Spring	Youngstown	Mahoning	
Glenwood Springs	Chillicothe	Ross	H (20).
La France Spring	Toledo	Lucas	
Minnehaha Spring	West Park	Cuyahoga	
Oak Ridge Mineral Springs	Green Springs	Sandusky	B, H (100).
Pine Tree Spring	Willoughby	Lake	
Pure Spring	Akron	Summit	
Purity Spring	South Euclid	Cuyahoga	
Sand Rock Mineral Spring	Canton	Stark	
Sulphur Lick Spring	Chillicothe	Ross	H (75).
Tallewanda Mineral Springs	College Corner	Preble	
Wheeler Mineral Springs	Youngstown	Mahoning	

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[f] Hotel capacity of city of Saratoga Springs is about 25,000.

[g] Town of Sharon Springs accommodates 3,000.

Springs or wells from which mineral waters were sold in 1923, by States—Continued

Oklahoma

Spring or well	Location		Bathing establishment (B) and hotel (H), with capacity (number of guests)
	Nearest post office	County	
Bromide, Medicine Water, and Sodium Chloride springs.	Platt National Park	Murray	
Everpure Well	Oklahoma City	Oklahoma	
Excelsior Well	do	do	
Guthrie Mineral Wells	Guthrie	Logan	
Kaiser Well	Oklahoma City	Oklahoma	
Kalium Well	Faxon	Comanche	
Sparkling Water Well	Shawnee	Pottawatomie	
Standard Wells	Tulsa	Tulsa	
White Sulphur Spring	Sapulpa	Creek	
Works Excelsior Mineral Wells	Comanche	Stephens	

Oregon

Calapooya Springs	Cottage Grove	Lane	B, H (24).
Cascade Mineral Springs	Cascadia	Linn	B, H (50).
Sam-O Springs	Baker	Baker	B.

Pennsylvania

Carnegie Alkaline Mineral Spring	Carnegie	Allegheny	
Chadwick Mineral Well	Cambridge Springs	Crawford	
Cloverdale Spring	Newville	Cumberland	
Crystal Rock Spring	Temple	Berks	
Dark Hollow Spring	Oakmont	Allegheny	
Ephrata Mountain Crystal Spring	Ephrata	Lancaster	
Great Oak Spring	Shenkel	Chester	
Juniata Springs	Altoona	Blair	
Kecksburg Artesian Mineral Springs	Mammoth	Westmoreland	
Keystone Spring	Taylorsville	Bucks	
Mountain Spring	Easton	Northampton	
Mountain Spring	Reading	Berks	
Mount Laurel Springs	Temple	do	
Original Magnesia Springs	Cambridge Springs	Crawford	
Polar Spring	Morrisville	Bucks	
Pulaski Mineral Spring	Pulaski	Lawrence	
Shawnee Mineral Spring	Plymouth	Luzerne	
Thurston's Carbonate Spring	Meadville	Crawford	
Tuckahoe Mineral Spring	Northumberland	Northumberland	
Valley Forge Springs	Valley Forge	Chester	
West Nanticoke Artesian Well	West Nanticoke	Luzerne	
White Ribbon Mineral Well	Harrison Valley	Potter	
White Star Spring	Easton	Northampton	

Rhode Island

Berry Spring	Pawtucket	Providence	
Girard Spring	North Providence	do	
Gladstone Spring	Narragansett Pier	Washington	
Holley Mineral Spring	Woonsocket	Providence	
Ochee Spring	Providence	do	
Prophet Spring	do	do	

South Carolina

Belleview Mineral Spring	Columbia	Richland	
Glendale Mineral Spring	Bamberg	Bamberg	
Glenn Springs	Glenn Springs	Spartanburg	H (375).
Mansfield Mineral Springs	Spartanburg	do	
Mertins Crystal Springs	Augusta, Ga	Aiken	
Shivar Springs	Shelton	Fairfield	

Springs or wells from which mineral waters were sold in 1923, by States—Continued

South Dakota

Spring or well	Location		Bathing establishment (B) and hotel (H), with capacity (number of guests)
	Nearest post office	County	
Culbert Spring	Aberdeen	Brown	
Johnson's Well	Milbank	Grant	
Minnehaha Springs	Sioux Falls	Minnehaha	

Tennessee

Spring or well	Nearest post office	County	Bathing establishment (B) and hotel (H), with capacity (number of guests)
Buena Vista Springs	Nashville	Davidson	
Bush Mineral Wells	do	do	
Darnell Well	Clarksville	Montgomery	
Galbraith Epsom Well	Galbraith Springs	Hawkins	H (125).
Hamilton Springs	Lebanon	Wilson	H (50).
Horn Springs	Hornsprings	do	B, H (200).
Pioneer Springs	Nashville	Davidson	
Red Boiling Springs	Red Boiling Springs	Macon	B, H (275).
Rhea Springs	Rhea Springs	Rhea	
Sulphur Springs	Ashland City	Cheatham	
Tate Spring	Tate Spring	Grainger	H (380).
Whittle Springs	Knoxville	Knox	H (150).
Wrights Spring	Mooresburg	Hawkins	

Texas

Spring or well	Nearest post office	County	Bathing establishment (B) and hotel (H), with capacity (number of guests)
Austin Well	Mineral Wells	Palo Pinto	(h)
Beauchamp Wells	Blossom	Lamar	
Crazy Wells	Mineral Wells	Palo Pinto	H (500).[h]
Mangum Mineral Well	Mangum	Eastland	
Marlin Hot Well	Marlin	Falls	B.[i]
Maurice Wells	Mangum	Eastland	
Mitchell Well	Greenville	Hunt	
Texas Carlsbad Wells	Mineral Wells	Palo Pinto	B.[h]
Weatherly Wells	Garrison	Nacogdoches	H (50).

Vermont

Spring or well	Nearest post office	County	Bathing establishment (B) and hotel (H), with capacity (number of guests)
Clarendon Nitrogen Spring	Clarendon	Rutland	H (200).
Cold Spring	Wells	do	

Virginia

Spring or well	Nearest post office	County	Bathing establishment (B) and hotel (H), with capacity (number of guests)
Alkaline Lithia Spring	Staunton	Augusta	
Alleghany Spring	Alleghany Springs	Montgomery	H (75).
Bear Lithia Springs	Elkton	Rockingham	
Beaufont Spring	Richmond	Chesterfield	
Blue Ridge Springs	Blue Ridge Springs	Botetourt	H (200).
Broad Rock Spring	Richmond	Chesterfield	
Buckhead Springs	Buckhead Springs	do	
Buffalo Mineral Springs	Buffalo Lithia Springs	Mecklenburg	H (200).
Burnett Mineral Springs	Culpeper	Culpeper	
Carter Springs	Danville	Pittsylvania	
Craig Healing Springs	Craig Healing Springs	Craig	B, H (450).
Crockett Springs	Crockett Springs	Montgomery	B, H (165).
Crystal Spring	Ivy Depot	Albemarle	
Farmville Lithia Springs	Farmville	Cumberland	
Fonticello Spring	Richmond	Chesterfield	
Green Springs	Trevilians	Louisa	
Healing Springs	Healing Springs	Bath	H (85).
Holly Hill Spring	Charlottesville	Albemarle	
Jeffress Lithia Silica Spring	Jeffress	Mecklenburg	H (20).
Mecklenburg Spring	Chase City	do	
Mico Well	Alexandria	Alexandria	
Nye Mineral Springs	Wytheville	Wythe	
Panacea Springs	Hopewell	Prince George	
Picketts Radio-active Spring	Worsham	Prince Edward	
Rockbridge Alum Springs	Rockbridge Alum Springs.	Rockbridge	
Rubino Healing Springs	Healing Springs	Bath	
Seawright Mineral Springs	Staunton	Augusta	
Virginia Etna Springs	Vinton	Roanoke	
Wyrick Spring	Crockett	Wythe	H (10).

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[h] Town of Mineral Wells accommodates 8,000.

[i] Town of Marlin accommodates 2,500.

Springs or wells from which mineral waters were sold in 1923, by States—Continued

Washington

Spring or well	Location		Bathing establishment (B) and hotel (H), with capacity (number of guests)
	Nearest post office	County	
Artesian Mineral Springs	Yakima	Yakima	B.
Klickitat Mineral Springs	Klickitat	Klickitat	
Schafers Medical Spring	Dishman	Spokane	
Sol Duc Hot Springs	Sol Duc	Clallam	B, H (80).

West Virginia

Capon Springs	Capon Springs	Hampshire	H (75).
Hamletts Sulphur Well	Alderson	Monroe	
Man-a-cea Water-Irondale Spring	Independence	Preston	
Saline Chalybeate Spring	Wheeling	Ohio	
Vigora Spring	do	do	
Walnut Hill	Charleston	Kanawha	
Wiley-Ice Springs	Fairmont	Marion	

Wisconsin

Allouez Spring	Green Bay	Brown	
Artesia Spring	Milwaukee	Milwaukee	
Bethania Mineral Springs	Osceola	Polk	
Bethesda Spring	Waukesha	Waukesha	
Clysmic Spring	do	do	
Crystal Spring	Sheboygan	Sheboygan	
Darlington Mineral Spring	Darlington	Lafayette	
Glenn Rock Waukesha Spring	Waukesha	Waukesha	
Indian Mineral Spring	Menomonee Falls	do	
Maribel Mineral Spring	Maribel	Manitowoc	
Nee-Ska-Ra Spring	Milwaukee	Milwaukee	
Old Faithful Spring	Wauwatosa	do	
Roxo Spring	Waukesha	Waukesha	
Sheridan Springs	Lake Geneva	Walworth	
Silurian Spring	Waukesha	Waukesha	
Silver Spring	Madison	Dane	
Sparkling Spring	Kenosha	Kenosha	
Still Rock Spring	Waukesha	Waukesha	
Sulphur Mineral Springs	Oshkosh	Winnebago	
Waukesha Fox Head Spring	Waukesha	Waukesha	
White Rock Spring	do	do	
Wilnette Spring	Racine	Racine	

Wyoming

Big Horn Hot Springs	Thermopolis	Hot Springs	B.[j] [k]
Paulson Well	Saratoga	Carbon	

[j] State bathhouse; free.

[k] Town of Thermopolis has three hotels and six apartment houses.

SALT, BROMINE, AND CALCIUM CHLORIDE

By K. W. Cottrell

SALT

PRODUCTION

Reports received from operators in the salt industry in 1923 indicate that demand was generally fair or good, but the cost of harvesting the evaporated salt was higher, and increased competition tended to reduce the price obtainable. The sales of salt in the United States in 1923 increased 5 per cent in quantity but only 1 per cent in value.

Salt sold or used by producers in the United States, 1918–1923

Year	Short tons				Value [a]	
	Manufactured (evaporated)	In brine	Rock salt	Total	Total	Average
1918	2, 724, 203	2, 830, 600	1, 683, 941	7, 238, 744	$26, 940, 361	$3. 72
1919	2, 392, 290	2, 850, 639	1, 639, 973	6, 882, 902	27, 074, 694	3. 93
1920	2, 409, 924	2, 819. 916	1, 610, 189	6, 840, 029	29, 894, 075	4. 37
1921	1, 931, 243	1, 577, 335	1, 472, 576	4, 981, 154	24, 557, 966	4. 93
1922	2, 276, 683	2, 569, 042	1, 947, 124	6, 792, 849	27, 464, 838	4. 04
1923	2, 239, 872	2, 787, 239	2, 103, 602	7, 130, 713	27, 795, 941	3. 90

[a] The values are f. o. b. mine or refinery and do not include cost of cooperage or containers.

Increases in both quantity and value were shown in six of the salt-producing States: Idaho increased 48 per cent in quantity and 29 per cent in value; Louisiana, 7 per cent in quantity and 9 per cent in value; New York, 5 per cent each in quantity and value; Virginia, 8 per cent in quantity and 82 per cent in value; West Virginia, 25 per cent in quantity but less than 1 per cent in value; and Nevada, from which no report was received in 1922, reported sales for 1923. California reported 2 per cent decrease in quantity but 10 per cent increase in value; Utah, less than 1 per cent decrease in quantity but 21 per cent increase in value. Kansas reported 11 per cent increase in quantity but 7 per cent decrease in value; Michigan, 6 per cent increase in quantity and less than 1 per cent decrease in value. Three States showed decreases in both quantity and value: New Mexico, 27 per cent in quantity, 9 per cent in value; Ohio, less than 1 per cent in quantity, 1 per cent in value; Texas, 12 per cent in quantity and 11 per cent in value. The leading States in the production of salt were Michigan, New York, Ohio, and Kansas, in the order named. The number of operating plants in California was 22, Michigan 21, Kansas and New York 13 each, Ohio 7, other States 1 to 6 plants each—a total of 97 active plants.

Salt sold or used by producers in the United States, 1920–1923, by States

State	1920		1921		1922		1923	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
California	212, 008	$1, 301, 426	193, 618	$1, 043, 912	257, 790	$1, 211, 197	252, 465	$1, 327, 917
Idaho	([a])	([a])	----------	----------	21	240	31	310
Kansas	783, 655	3, 839, 409	665, 968	3, 268, 661	759, 459	3, 849, 427	845, 163	3, 570, 135
Louisiana	265, 085	1, 517, 414	([a])	([a])	336, 852	1, 657, 708	359, 161	1, 808, 762
Michigan	2, 262, 915	10, 698, 674	1, 427, 465	7, 439, 445	2, 005, 088	8, 693, 604	2, 127, 412	8, 684, 148
New Mexico	([a])	([a])	([a])	([a])	718	5, 747	525	5, 250
New York	1, 903, 101	7, 584, 921	1, 455, 014	6, 505, 041	1, 960, 867	7, 066, 409	2, 065, 842	7, 431, 155
Ohio	1, 057, 802	3, 324, 492	749, 349	3, 284, 952	1, 105, 757	3, 749, 564	1, 102, 387	3, 695, 248
Porto Rico	----------	----------	7, 418	24, 908	([a])	([a])	5, 875	8, 225
Texas	91, 103	667, 835	([a])	([a])	([a])	([a])	([a])	([a])
Utah	75, 259	546, 186	68, 874	491, 354	81, 909	387, 093	81, 449	468, 765
West Virginia	29, 802	348, 556	27, 964	320, 537	25, 188	283, 257	31, 589	284, 196
Undistributed [b]	159, 299	65, 162	385, 484	2, 179, 156	259, 200	560, 592	258, 814	511, 830
	6, 840, 029	29, 894, 075	4, 981, 154	24, 557, 966	6, 792, 849	27, 464, 838	7, 130, 713	27, 795, 941

[a] Included under "Undistributed."

[b] 1920: Hawaii, Idaho, Nevada, New Mexico, and Virginia; 1921: Hawaii, Louisiana, New Mexico, Texas, and Virginia; 1922: Porto Rico, Texas, and Virginia; 1923: Nevada, Texas, and Virginia.

Comparison with figures for 1922 shows an increase in both quantity and value in only three varieties—salt evaporated in vacuum pans, rock salt, and salt in brine. A decrease was shown in both quantity and value of salt evaporated in open pans or grainers and in pressed blocks from evaporated salt. Solar evaporated salt and pressed blocks from rock salt decreased in quantity but increased in value. The average value of all salt was 14 cents a ton less than in 1922.

Salt sold or used by producers in the United States in 1923, by method of manufacture

Method of manufacture	Short tons	Value	
		Total	Average
Evaporated in open pans or grainers	768, 616	$7, 434, 325	$9. 67
Evaporated in vacuum pans	1, 035, 434	8, 300, 130	8. 02
Solar evaporated	307, 749	1, 388, 480	4. 51
Pressed blocks from evaporated salt	128, 073	1, 263, 246	9. 86
Rock	2, 065, 559	7, 562, 117	3. 66
Pressed blocks from rock salt	38, 043	281, 302	7. 39
Salt in brine (sold or used as such)	2, 787, 239	1, 566, 341	. 56
	7, 130, 713	27, 795, 941	3. 90

Rock salt was reported by 24 plants in 8 States. New York, Kansas, and Louisiana were the leading States, reporting 46, 25, and 17 per cent, respectively, of the total sales of rock salt.

Rock salt sold in the United States, 1918–1923

Year	Short tons	Value	
		Total	Average
1918	1, 683, 941	$5, 684, 661	$3. 38
1919	1, 639, 973	6, 224, 920	3. 80
1920	[a] 1, 610, 189	[a] 7, 048, 315	4. 38
1921	[a] 1, 472, 576	[a] 6, 693, 923	4. 55
1922	[a] 1, 947, 124	[a] 7, 489, 644	3. 85
1923	[a] 2, 103, 602	[a] 7, 843, 419	3. 73

[a] Includes pressed blocks made of rock salt, as follows: 1920, 15,182 tons, valued at $172,211; 1921, 20,148 tons, valued at $169,244; 1922, 38,593 tons, valued at $245,174; 1923, 38,043 tons, valued at $281,302.

Evaporated salt sold or used by producers in the United States in 1922 and 1923, by States

State	1922		1923	
	Short tons	Value	Short tons	Value
California	249, 483	$1, 169, 662	245, 015	$1, 290, 667
Kansas	302, 700	2, 651, 598	313, 701	2, 305, 299
Michigan	845, 667	7, 383, 596	806, 165	7, 346, 432
New Mexico	-----	-----	525	5, 250
New York	418, 498	3, 128, 918	391, 787	3, 299, 203
Ohio	278, 870	2, 913, 363	301, 309	2, 884, 360
Porto Rico	(a)	(a)	5, 875	8, 225
Utah	77, 625	368, 543	78, 993	457, 662
West Virginia	25, 188	283, 257	31, 589	284, 196
Undistributed [b]	78, 652	573, 822	64, 913	504, 887
	2, 276, 683	18, 472, 759	2, 239, 872	18, 386, 181
Percentage of increase in 1922 and of decrease in 1923	+17. 9	+9. 7	−1. 6	−0. 5

[a] Included under "Undistributed."
[b] 1922: Idaho, Louisiana, Porto Rico, and Texas; 1923: Louisiana, Nevada, and Texas.

The production of pressed blocks in the last six years as reported by the original producers of the salt and shown in the following table does not represent the entire pressed-block industry, because some firms that do not produce salt are making pressed blocks of salt bought in the open market:

Pressed salt blocks sold by original producers of the salt in the United States, 1918–1923

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1918	94, 150	$939, 900	$9. 98	1921	117, 739	$1, 275, 483	$10. 83
1919	119, 510	1, 358, 757	11. 37	1922	172, 682	1, 554, 429	9. 00
1920	129, 224	1, 515, 041	11. 72	1923	166, 116	1, 544, 548	9. 30

Of the total supply of salt in the United States in 1923 almost 99 per cent was of domestic production and less than 2 per cent was imported.

Supply of salt for domestic consumption, 1919–1923, in short tons

Source	1919	1920	1921	1922	1923
Domestic production	6, 882, 902	6, 840, 029	4, 981, 154	6, 792, 849	7, 130, 713
Imports	59, 514	137, 654	93, 095	111, 710	88, 750
	6, 942, 416	6, 977, 683	5, 074, 249	6, 904, 559	7, 219, 463
Exports	119, 416	139, 272	109, 563	134, 989	125, 529
New supply	6, 823, 000	6, 838, 411	4, 964, 686	6, 769, 570	7, 093, 934
Comparison with preceding year	−319, 251	+15, 411	−1, 873, 725	+1, 804, 884	+324, 364
Percentage of imports to new supply	0. 9	2. 0	1. 9	1. 7	1. 3

IMPORTS AND EXPORTS[1]

According to figures obtained from the Bureau of Foreign and Domestic Commerce, Department of Commerce, and converted from pounds, as reported by that bureau, to short tons, the salt imported for consumption in the United States in the last five years has been as follows:

Salt imported for consumption in the United States, 1919–1923

Year	In bags, barrels, and other packages		In bulk		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	9, 676	$137, 627	49, 838	$105, 077	59, 514	$242, 704
1920	29, 567	240, 923	108, 087	435, 576	137, 654	676, 499
1921	38, 374	333, 282	54, 721	197, 749	93, 095	531, 031
1922	[a] 24, 392	[a] 216, 718	89, 530	305, 620	113, 922	522, 338
1923	[a] 36, 185	[a] 240, 970	52, 565	142, 288	88, 750	383, 258

[a] Includes salt imported for curing fish, as follows: 1922, 2,252 short tons, valued at $5,549; 1923, 16,472 short tons, valued at $46,260.

Salt imported into the United States, 1920–1923, by countries

[General imports]

Country	1920		1921		1922		1923	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
North America:								
Canada	3, 156, 200	$22, 188	1, 692, 000	$13, 560	1, 889, 300	$14, 547	3, 064, 500	$17, 736
Guatemala							500	26
Mexico			18, 200	142				
Newfoundland and Labrador					115, 000	2, 800		
West Indies:								
British—								
Barbados							1, 012, 600	1, 153
Jamaica					1, 034, 100	1, 379	3, 575, 700	4, 169
Trinidad and Tobago					3, 265, 400	3, 668		
Other British	74, 961, 600	124, 654	35, 761, 400	54, 271	59, 731, 400	77, 966	70, 100, 600	79, 781
Dutch	20, 415, 600	39, 571	9, 603, 200	12, 425	11, 016, 100	15, 713	3, 050, 600	4, 431
French	1, 106, 200	2, 868	62, 000	151			2, 390, 000	2, 785
Virgin Islands of the United States			902, 800	1, 788				
South America:								
Argentina	228, 400	1, 142						
Chile					17, 300	99		
Venezuela	75, 600	137						

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[1] The tables of imports and exports were compiled by James A. Dorsey, of the Geological Survey.

Salt imported into the United States, 1920–1923, by countries—Continued

Country	1920		1921		1922		1923	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Europe:								
Belgium	----------	-------	----------	-------	----------	-------	440,000	$2,070
Germany	47,669,300	$143,158	82,712,700	$250,614	110,656,000	$274,511	57,453,100	135,959
Italy	----------	-------	5,846,400	8,347	----------	-------	10,304,000	10,350
Netherlands	314,700	294	----------	-------	----------	-------	561,100	2,503
Portugal	17,008,000	34,624	2,912,000	2,850	----------	-------	----------	-------
Spain	65,732,100	71,158	12,494,400	29,597	25,552,600	27,047	17,277,600	16,396
United Kingdom—								
England	44,281,500	236,374	16,676,700	123,999	14,104,100	105,172	16,448,500	121,253
Scotland	200	1	----------	-------	----------	-------	----------	-------
Asia:								
Hongkong	100	17	1,100	11	----------	-------	200	57
Japan	300	4	500	19	3,000	24	100	3
Turkey	----------	-------	700	6	----------	-------	----------	-------
Africa:								
Algeria and Tunis	----------	-------	----------	-------	----------	-------	11,200,000	5,646
Canary Islands	358,400	309	----------	-------	----------	-------	----------	-------
French Africa	----------	-------	17,506,000	33,251	----------	-------	----------	-------
Portuguese Africa	----------	-------	----------	-------	243,200	110	----------	-------
	275,308,200	676,499	186,190,100	531,031	227,627,500	523,036	196,879,100	404,318

Salt exported from the United States, 1918–1923

Year	Short tons	Value	Year	Short tons	Value
1918	136,783	$1,677,577	1921	109,563	$1,415,471
1919	119,416	1,396,625	1922	134,989	1,429,172
1920	139,272	1,901,593	1923	125,529	1,211,226

Salt exported from the United States, 1920–1923, by countries

Country	1920		1921		1922		1923	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
North America:								
Bermuda	138,221	$1,697	128,284	$2,128	182,100	$2,130	186,530	$2,350
British Honduras	300,285	3,404	262,212	2,813	378,984	3,833	344,563	3,028
Canada	182,799,386	959,451	163,278,742	908,753	208,495,592	928,477	188,954,715	696,709
Central American States:								
Costa Rica	438,134	4,995	59,380	1,145	200,676	1,658	185,474	2,000
Guatemala	132,098	2,219	128,559	2,182	891,415	5,373	901,808	5,394
Honduras	2,641,512	23,022	1,859,679	23,202	2,377,529	21,294	2,938,624	27,093
Nicaragua	566,838	8,908	451,557	8,046	537,263	7,611	633,060	8,482
Panama	3,137,777	36,457	2,236,694	24,069	1,403,816	13,522	1,802,170	16,676
Salvador	2,000	60	1,821	82	792	54	40,096	274
Mexico	10,647,691	130,022	9,305,018	113,261	9,562,151	94,964	7,375,088	88,071
Miquelon, Langley, etc	1,520	42	576	11	1,500	40	2,564	78
Newfoundland and Labrador	879,888	7,660	603,490	5,582	112,200	554	678,640	1,135
West Indies—								
British:								
Barbados	1,450	26	724	25	----------	-------	100	4
Jamaica	78,503	1,405	196,438	1,392	4,436	88	4,496	107
Trinidad and Tobago	15,908	445	6,098	244	24	3	----------	-------
Other British	10,551	330	----------	-------	37,369	421	15,415	297
Cuba	62,569,363	519,224	30,965,628	234,577	41,443,389	268,463	38,895,196	267,960
Dominican Republic	348,192	7,151	426,830	7,083	186,315	4,621	199,527	5,423
Dutch	----------	-------	50	5	96	5	440	23
French	8,539	367	8,500	320	4,396	122	934	27
Haiti	12,804	529	8,422	292	4,678	197	4,428	155
Virgin Islands of the United States	10,080	228	12,341	261	4,716	76	34,634	159

Salt exported from the United States, 1920–1923, by countries—Continued

Country	1920		1921		1922		1923	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
South America:								
Argentina	143,035	$4,504	20,730	$283	275	$14	383,216	$2,939
Bolivia	1,575	13	-----	-----	-----	-----	-----	-----
Brazil	3,831	217	528,136	11,130	70	11	-----	-----
Chile	20,386	647	-----	-----	1,460	63	705	24
Colombia	75,933	1,244	55,242	770	80,150	1,348	100,380	1,541
Ecuador	1,700	22	-----	-----	202	12	-----	-----
Guiana:								
British	9,739	373	280	4	-----	-----	-----	-----
Dutch	13,500	215	1,500	60	-----	-----	14,255	232
French	11,112	344	-----	-----	-----	-----	-----	-----
Paraguay	-----	-----	-----	-----	-----	-----	1,701	74
Peru	1,920	60	-----	-----	6,560	40	-----	-----
Uruguay	54	2	-----	-----	-----	-----	22,000	118
Venezuela	1,049	20	1,440	29	2,428	36	16,102	307
Europe:								
Belgium	600	16	-----	-----	-----	-----	-----	-----
Denmark	4,800	150	-----	-----	-----	-----	4,800	165
Esthonia	-----	-----	-----	-----	300	10	-----	-----
France	38,140	3,654	1,344	48	-----	-----	24,000	210
Germany	2,051	30	-----	-----	138	4	-----	-----
Greece	112	2	-----	-----	8,800	89	-----	-----
Iceland and Faroe Islands	2,000	77	2,400	95	3,700	115	-----	-----
Latvia	-----	-----	-----	-----	672	17	-----	-----
Netherlands	-----	-----	-----	-----	2,500	79	-----	-----
Poland and Danzig	395	19	-----	-----	-----	-----	880	50
Rumania	274	17	-----	-----	700	15	-----	-----
Russia	6,000	96	3,380	44	9,924	127	764	28
Spain	92	8	-----	-----	2,240	11	-----	-----
Sweden	778,748	14,366	-----	-----	-----	-----	-----	-----
Turkey	4,720	118	-----	-----	-----	-----	-----	-----
United Kingdom—England	227,600	1,226	10,000	150	3,969	114	-----	-----
Asia:								
Armenia and Kurdistan	-----	-----	-----	-----	785	37	-----	-----
China	46,488	3,097	22,093	1,996	29,759	2,344	31,522	2,239
Kwangtung, leased territory	4,400	425	504	36	112	12	1,530	88
Ceylon	-----	-----	-----	-----	1,160	125	1,503	155
Chosen	6,802	192	7,147	425	4,448	130	6,520	188
East Indies—								
British—								
India	6,169	634	6,900	463	5,121	242	5,404	535
Straits Settlements	1,458	148	1,234	126	2,387	255	168	18
Other British	2,776	207	3,920	238	-----	-----	-----	-----
Dutch	16,134	1,407	4,213	262	-----	-----	384	44
French	120	14	-----	-----	-----	-----	-----	-----
Far Eastern Republic	-----	-----	3,240	280	7,488	264	20,180	168
Indo-China, French	-----	-----	-----	-----	-----	-----	1,417	87
Hongkong	15,569	1,049	90,574	3,646	36,853	2,232	30,687	2,205
Japan	8,571,850	66,622	6,708,380	28,448	496,750	1,944	2,167,294	10,762
Java and Madura	-----	-----	-----	-----	5,736	556	3,726	380
Palestine and Syria	-----	-----	-----	-----	480	47	-----	-----
Russia	96,529	3,279	10,810	278	2,100	115	-----	-----
Siam	3,044	196	1,065	105	1,359	147	3,492	376
Turkey	176	12	872	48	-----	-----	-----	-----
Africa:								
Belgian Congo	3,143	95	2,420	66	21,000	268	-----	-----
British Africa—								
East	700	21	-----	-----	-----	-----	-----	-----
South	100	2	-----	-----	-----	-----	2,880	124
West	2,274	28	265	7	214	8	-----	-----
Canary Islands	96	4	-----	-----	-----	-----	-----	-----
Egypt	-----	-----	-----	-----	-----	-----	375	14
Liberia	302	14	23	1	-----	-----	-----	-----
Portuguese Africa—								
East	1,216	22	1,215	31	-----	-----	4,560	50
Other	-----	-----	-----	-----	-----	-----	399	18
Oceania:								
Australia	1,155,704	29,652	900,918	17,317	2,530,774	44,137	1,647,691	31,862
British Oceania	24,949	679	14,240	345	17,170	316	11,500	187
French Oceania	295,672	4,111	217,218	2,169	230,601	2,236	261,357	3,412
New Zealand	1,932,538	43,065	486,898	8,261	444,488	9,157	364,180	9,153
Other Oceania	13,430	280	4,446	103	-----	-----	4,326	73
Philippine Islands	252,593	11,256	72,157	2,734	185,244	8,989	2,718,770	17,955
	278,544,338	1,901,593	219,126,247	1,415,471	269,977,554	1,429,172	251,057,170	1,211,226

WORLD'S PRODUCTION

The quantity of salt produced in the principal countries of the world during the ten years 1913–1922 is shown in the following table compiled by W. I. Whiteside, of the United States Geological Survey.

Salt produced in the principal countries of the world, 1913–1922, in metric tons

Country [a]	1913	1914	1915	1916	1917
North America:					
British West Indies—					
Bahamas	([b])	([b])	([b])	([b])	([b])
Ragged Island [c]	([b])	([b])	([b])	([b])	([b])
Turks and Caicos islands [c]	([b])	([b])	([b])	([b])	([b])
Canada	91, 436	97, 103	108, 771	120, 567	126, 016
Dutch West Indies [c]	13, 417	14, 447	12, 599	8, 624	15, 441
Mexico [d]	67, 000	67, 000	67, 000	67, 000	67, 000
Republic of Panama [c]	([b])	([b])	([b])	([b])	([b])
United States—Rock salt	963, 689	962, 340	1, 057, 216	1, 241, 342	1, 456, 047
Other	3, 405, 201	3, 458, 036	3, 798, 382	4, 530, 959	4, 874, 416
South America:					
Argentina [e]	54, 917	63, 895	70, 507	111, 522	157, 846
Chile	19, 558	24, 805	30, 266	30, 785	37, 694
Colombia [d]	29, 000	29, 000	29, 000	29, 000	29, 000
Peru	24, 433	25, 933	25, 729	26, 066	27, 073
Venezuela	([b])	([b])	([b])	([b])	([b])
Europe:					
Austria [f]—Rock salt	128, 734	65, 728	101, 904	152, 228	165, 501
Other [h]	236, 018	189, 395	178, 155	218, 505	190, 436
Bosnia-Herzegovina [i]	27, 282	25, 729	25, 849	37, 764	43, 142
Czechoslovakia	([k])	([k])	([k])	([k])	([k])
France—Rock salt and salt from springs	899, 502	594, 149	541, 140	673, 670	721, 008
Other	382, 476	255, 288	258, 762	447, 772	216, 585
Germany—Rock salt	1, 391, 738	1, 297, 636	1, 314, 864	1, 838, 164	2, 065, 824
Other	675, 900	643, 400	581, 800	596, 300	511, 300
Greece	19, 215	29, 717	16, 856	34, 522	45, 560
Hungary—Rock salt	190, 126	195, 515	194, 551	303, 000	346, 000
Other	66, 322	56, 871	53, 796		
Italy—Rock salt	41, 323	41, 715	33, 267	50, 294	43, 042
Other	602, 755	531, 388	400, 070	346, 956	335, 399
Poland	([l])	([l])	([l])	([l])	([l])
Portugal [c]	([b])	([b])	([b])	([b])	([b])
Rumania	335, 000	365, 000	352, 000	325, 000	420, 000
Russia [m]—Rock salt	556, 163	533, 575	([b])	([b])	([b])
Other	1, 439, 329	1, 399, 066			
Spain—Rock salt	26, 238	337, 157	305, 035	348, 939	309, 413
Other	584, 191	590, 610	488, 305	546, 990	471, 693
Switzerland	515, 000	519, 000	440, 000	453, 000	445, 000
United Kingdom—					
Great Britain and Isle of Man—					
Rock salt	173, 929	150, 365	103, 436	105, 664	97, 112
Other [n]	2, 065, 818	1, 910, 168	1, 904, 339	1, 860, 812	1, 921, 055
Ireland—Rock salt	44, 087	42, 679	30, 020	25, 437	27, 536
Other [n]	([n])	([n])	([n])	([n])	([n])
Yugoslavia	([o])	([o])	([o])	([o])	([o])
Asia:					
British India (including Aden)—					
Rock salt	163, 770	159, 063	182, 678	187, 872	183, 872
Other	1, 333, 063	1, 210, 801	1, 590, 860	1, 324, 670	1, 266, 695

[a] In addition to the countries shown in the table there are others in which salt is produced. For some of these, figures of production are available for years prior to those given in the table, as follows: Brazil, 1906, 210,853 tons; Persia, 1912–13, 757 tons (exported); Portuguese East Africa, 1912, 1,408 tons; Tanganyika Territory, formerly German East Africa, 1912, 1,850 tons; Turkey, 1908–9, 335,923 tons.

[b] Data not available.

[c] Exports.

[d] Estimated annual production.

[e] Railway shipments.

[f] Exclusive of Bosnia-Herzegovina, which is shown separately.

[h] Includes salt content of brine.

[i] In addition to these amounts there was reported salt in brine, as follows: 1913, 1,894,532 hectoliters; 1914, 1,577,248 hectoliters; 1915, 1,465,354 hectoliters; 1916, 2,156, 685 hectoliters; 1917, 2,353,910 hectoliters.

[k] See Austria and Hungary.

[l] See Russia.

[m] Includes Asiatic Russia.

[n] No separate data of brine-salt production for Ireland available. Ireland's production included with Great Britain.

[o] See Austria.

Salt produced in the principal countries of the world, 1913–1922, in metric tons—Continued

Country	1913	1914	1915	1916	1917
Asia—Continued.					
Ceylon	(b)	(b)	(b)	(b)	(b)
China (including Kwangtung) [p]	(b)	(b)	(b)	(b)	(b)
Chosen [q]	(b)	(b)	(b)	(b)	(b)
Cyprus [c]	(b)	(b)	(b)	(b)	(b)
Japan—Japan proper [r]	640,007	610,906	597,161	620,495	602,411
Taiwan	74,059	91,842	150,995	105,654	111,442
Portuguese India [d]	12,000	12,000	12,000	12,000	12,000
Siam [c]	(b)	(b)	(b)	(b)	(b)
Africa:					
Algeria	27,000	39,000	31,000	35,000	36,000
Belgian Congo [d]	80	80	80	80	80
British Somaliland [c]	(b)	(b)	(b)	(b)	(b)
Egypt [c]	(b)	(b)	(b)	(b)	(b)
Eritrea	20,000	20,000	20,000	20,000	20,000
Mauritius [d]	(b)	(b)	(b)	(b)	(b)
Nigeria, Northern [d]	400	400	400	400	400
Portuguese West Africa (Angola) [c]	(b)	(b)	(b)	(b)	(b)
Tunisia	(b)	(b)	(b)	(b)	(b)
Union of South Africa	43,537	36,550	40,917	51,044	52,602
Oceania:					
Australia—(South Australia [t])	66,043	66,043	65,027	67,466	47,610
Dutch East Indies	102,091	101,733	110,690	116,001	122,604
Philippine Islands	19,500	20,000	22,500	24,750	26,000

Country [a]	1918	1919	1920	1921	1922
North America:					
British West Indies—					
Bahamas	(b)	4,270	[c] 1,830	[c] 3,200	2,100
Ragged Island [c]	(b)	1,260	509	(b)	(b)
Turks and Caicos islands [c]	21,854	51,000	48,394	(b)	46,939
Canada	119,500	134,536	190,376	149,374	164,920
Dutch West Indies [c]	11,652	8,191	25,524	17,810	18,459
Mexico [d]	67,000	67,000	67,000	67,000	67,000
Republic of Panama [c]	(b)	(b)	826	677	826
United States—Rock salt	1,527,638	1,487,751	1,460,731	1,335,891	1,766,392
Other	5,039,206	4,756,280	4,744,406	3,182,912	4,395,945
South America:					
Argentina [e]	210,171	140,248	82,464	75,968	93,698
Chile	54,536	29,454	33,951	39,466	33,743
Colombia [d]	29,000	29,000	29,000	29,000	29,000
Peru	26,663	27,724	27,172	26,350	26,126
Venezuela	(b)	31,479	(b)	(b)	(b)
Europe:					
Austria [f]—Rock salt	[g] 604	498	2,455	1,815	2,328
Other [h]	[g] 133,787	95,434	79,431	75,236	85,695
Bosnia-Herzegovina [i]	(b)	(j)	(j)	(j)	(j)
Czechoslovakia	(k)	4,944	30,990	91,200	128,179
France—Rock salt and salt from springs	614,990	649,015	840,001	793,151	541,340
Other	477,591	597,495	432,776	212,251	238,250

[a] In addition to the countries shown in the table there are others in which salt is produced. For some of these, figures of production are available for years prior to those given in the table, as follows: Brazil, 1906, 210,853 tons; Persia, 1912–13, 757 tons (exported); Portuguese East Africa, 1912, 1,408 tons; Tanganyika Territory, formerly German East Africa, 1912, 1,850 tons; Turkey, 1908–9, 335,923 tons.

[b] Data not available.

[c] Exports.

[d] Estimated annual production.

[e] Railway shipments.

[f] Exclusive of Bosnia-Herzegovina, which is shown separately.

[g] Present Republic.

[h] Includes salt content of brine.

[i] In addition to these amounts there was reported salt in brine, as follows: 1913, 1,894,532 hectoliters; 1914, 1,577,248 hectoliters; 1915, 1,465,354 hectoliters; 1916, 2,156,685 hectoliters; 1917, 2,353,910 hectoliters.

[j] Bosnia-Herzegovina now a part of Yugoslavia.

[k] See Austria and Hungary.

[p] Estimated on approximate gross revenue under Salt Gabelle.

[q] During the years 1909–1913 works were completed with an annual capacity of 100,000,000 kin (60,000 metric tons) (Financial and Economic Annual of Japan, 1919). Additions were made in 1920 which increased the annual capacity to 119,000,000 kin (71,400 metric tons) (Financial and Economic Annual of Japan, 1922).

[r] Fiscal year ending Mar. 31 following that stated.

[t] The other States of Australia produce salt, but no figures of production are available.

Salt produced in the principal countries of the world, 1918–1922, in metric tons—Continued

Country	1918	1919	1920	1921	1922
Europe—Continued.					
Germany—Rock salt	2,344,481	1,487,849	2,596,825	1,655,753	2,319,896
Other	375,000	291,719	335,900	304,466	360,464
Greece	31,000	28,831	57,285	65,000	67,500
Hungary	(b)	(b)	(b)	(b)	(b)
Italy—Rock salt	41,947	41,313	46,989	45,440	49,802
Other	451,503	494,435	675,129	468,151	740,507
Netherlands—Rock salt	-----	5,244	24,857	25,465	28,334
Poland	(l)	169,203	245,604	301,612	295,403
Portugal [c]	(b)	81,427	118,368	(b)	(b)
Rumania	266,000	259,167	246,977	232,818	285,212
Russia [m]—Rock salt Other	(b)	570,000	579,162	983,676	789,516
Spain—Rock salt	320,531	37,801	62,647	37,996	114,400
Other	345,454	443,490	928,898	475,143	566,480
Switzerland	494,000	421,000	448,000	339,000	(b)
United Kingdom—					
Great Britain and Isle of Man—					
Rock salt	88,646	72,545	86,358	24,525	26,998
Other [n]	1,892,017	1,846,307	2,083,194	1,368,535	1,874,434
Ireland—Rock salt	27,066	19,853	23,460	11,760	(b)
Other [n]	(n)	(n)	(n)	(n)	(n)
Yugoslavia	(o)	23,400	23,400	34,922	43,872
Asia:					
British India (including Aden)—					
Rock salt	188,826	208,625	213,207	150,414	210,639
Other	1,697,671	1,712,866	1,443,079	1,407,881	1,469,804
Ceylon	60,278	16,229	16,775	13,952	39,623
China (including Kwangtung) [p]	(b)	2,146,000	2,104,000	2,075,000	(b)
Chosen [q]	(b)	50,690	54,921	(b)	(b)
Cyprus [c]	(b)	1,503	625	899	14,247
Japan—Japan proper [r]	403,205	589,005	[s] 543,956	515,103	(b)
Taiwan	109,199	73,158	51,976	101,540	(b)
Portuguese India [d]	12,000	12,000	12,000	12,000	12,000
Siam [c]	(b)	63,430	50,737	29,824	26,542
Africa:					
Algeria	29,000	27,482	28,169	18,255	20,208
Belgian Congo [d]	80	80	80	80	80
British Somaliland [c]	(b)	516	504	906	1,572
Egypt [c]	(b)	227,229	225,811	153,651	186,793
Eritrea	20,000	20,000	20,000	20,000	20,000
Mauritius [d]	(b)	1,830	1,830	1,830	1,520
Nigeria, Northern [d]	400	400	400	400	400
Portuguese West Africa (Angola) [c]	(b)	1,671	2,746	2,175	(b)
Tunisia	(b)	16,942	41,086	32,800	51,950
Union of South Africa	63,279	77,265	80,603	62,033	(b)
Oceania:					
Australia (South Australia [t])	89,940	70,284	72,008	57,399	49,438
Dutch East Indies	125,495	127,423	135,660	133,522	(b)
Philippine Islands	30,000	32,000	62,383	(b)	(b)

[b] Data not available.

[c] Exports.

[d] Estimated annual production.

[l] See Russia.

[m] Includes Asiatic Russia.

[n] No separate data of brine-salt production for Ireland available. Ireland's production included with Great Britain.

[o] See Austria.

[p] Estimated on approximate gross revenue under Salt Gabelle.

[q] During the years 1909–1913 works were completed with an annual capacity of 100,000,000 kin (60,000 metric tons) (Financial and Economic Annual of Japan, 1919). Additions were made in 1920 which increased the annual capacity to 119,000,000 kin (71,400 metric tons) (Financial and Economic Annual of Japan, 1922).

[r] Fiscal year ending Mar. 31 following that stated.

[s] In addition there was reported a production of brine salt in Karafuto amounting to 927,905 hectoliters.

[t] The other States of Australia produce salt, but no figures of production are available.

BROMINE

The bromine sold by producers in 1923 was 16 per cent less in quantity and 3 per cent less in value than in 1922. The average value increased 13 per cent. A large part of the output is not sold as bromine but in the form of potassium and sodium bromide and other salts. The figures given in the following table include the bromine content of these salts. The values given in the table are reported to the Geological Survey by the producers and represent averages for the year f. o. b. at the plants.

Bromine sold by producers in the United States, 1918–1923

Year	Pounds	Value		Year	Pounds	Value	
		Total	Average			Total	Average
1918	1,727,156	$970,099	$0.56	1921	711,953	$172,759	$0.24
1919	1,854,971	1,234,969	.67	1922	1,005,174	150,668	.15
1920	1,160,584	745,381	.64	1923	842,352	146,176	.17

The wholesale price per pound of bulk bromine as quoted in the New York market in 1923, according to Chemical and Metallurgical Engineering, ranged from 27 to 28 cents in January, from 25 to 27 cents from February 1 until about March 10, then increased to 28 to 30 cents and remained at that level until the end of the year, except for the second week in August, when it rose to 29 to 31 cents.

Bromine had not been imported into the United States for several years prior to 1921, when imports of 300 pounds, valued at $84, were reported by the Bureau of Foreign and Domestic Commerce. In 1922 the imports were 1,094 pounds, valued at $339; in 1923, 782 pounds, valued at $1,171. The exports of bromine are not separately recorded.

CALCIUM CHLORIDE

The calcium chloride reported in the following table is an original constituent of the natural brine produced in connection with the manufacture of salt and bromine in California, Michigan, Ohio, and West Virginia. These statistics cover the direct production of calcium chloride from mineral raw materials only. A further large output made by manufacturing processes used in the chemical industries is not reported.

Calcium-magnesium chloride from natural brines sold by producers in the United States, 1918–1923

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1918	26,624	$503,452	$18.91	1921	23,672	$510,723	$21.57
1919	26,123	321,596	12.31	1922	33,067	571,326	17.28
1920	27,849	539,471	19.37	1923	44,961	663,384	14.75

Imports of calcium chloride in 1923 amounted to 3,232 short tons, valued at $48,527, according to the Bureau of Foreign and Domestic Commerce. From September 22 to December 31, 1922, 740 tons, valued at $8,563, was imported. Similar imports were not separately recorded prior to the new tariff.

Exports of calcium chloride are not separately shown.

ASPHALT AND RELATED BITUMENS

By K. W. Cottrell

GENERAL FEATURES

The number of operators reporting the production of asphalt and related bitumens in 1923 was 40, of whom 15 produced native asphaltic materials, 13 manufactured asphalt from domestic petroleum only, 8 from petroleum of Mexican origin, and 4 from both domestic and Mexican petroleum.

Native asphalt and bitumens.—The asphaltic and bituminous materials mined or quarried in the United States include bituminous or asphalt-bearing rock and mineral bitumens and waxes—gilsonite, grahamite, impsonite, ozokerite, and wurtzilite. Wurtzilite, mined in Utah, has also been sold under the name elaterite. Producers reported sales in 1923 of all these varieties except grahamite and impsonite. The material produced in largest quantity and value is bituminous rock, mined in Kentucky, Texas, Oklahoma, California, and Alabama (named in the order of magnitude of output) and used as paving material. The other bituminous products are used in many ways, as for the manufacture of paints, varnishes, and cements. The sales of native asphalt and related bitumens in the United States in 1923 increased 22 per cent in quantity and 28 per cent in value.

Manufactured asphalt.—In the production of asphalt from domestic petroleum California, with 8 operators reporting, ranked first in both quantity and value; Texas, with 3 operators reporting, ranked second; and Illinois, with 4 operators reporting, ranked third. These three States produced 45, 24, and 15 per cent respectively of the total quantity of asphalt manufactured during 1923. Sales of asphalt manufactured from domestic petroleum increased 24 per cent in quantity and 26 per cent in value. Those of asphalt manufactured from Mexican petroleum showed an increase of only 11 per cent in quantity but of 21 per cent in value.

Ichthyol.—No production of domestic ichthyol was reported for 1923. The property of the Meadows Chemical Corporation, of Durant, N. Y., which manufactured ichthyol from material obtained near Burnet, Tex., has been bought by the Dayton Chemical Co., Dayton, Ohio, which plans to manufacture ichthyol and preparations containing it. The imports of ichthyol and ichthyol substitutes amounted to only 20 pounds, valued at $15, in 1923, as compared with 74,330 pounds, valued at $89,150, in 1922. The imports have probably not declined to the extent indicated by these figures but have probably not been recorded because they are differently designated since the passage of the tariff act of 1922.

The Asphalt Association.—The members of the asphalt industry established in 1919 the Asphalt Association, which, in addition to other activities, is engaged in collecting and disseminating information useful to both producers and users of asphalt. Any one desiring such information may address the association, 25 West Forty-third Street, New York City, or at the following branch offices:

25 North Pearl Street, Albany, N. Y.
302 Latta Arcade Building, Charlotte, N. C.
729 Hearst Building, Hearst Square, Chicago, Ill.
314 Dwight Building, Kansas City, Mo.

PRODUCTION

Native asphalt and related bitumens sold in the United States, 1918–1923

[Value f. o. b. mine]

Year	Short tons	Value	Year	Short tons	Value
1918	60,034	$780,808	1921	296,412	$1,985,583
1919	88,281	682,989	1922	327,792	2,253,180
1920	198,497	1,213,908	1923	400,236	2,885,631

Domestic asphalt sold at mines and refineries in the United States, 1918–1923, by varieties

[Value f. o. b. mine or refinery]

Variety	1918		1919		1920	
	Short tons	Value	Short tons	Value	Short tons	Value
Petroleum asphalt [a]	604,723	$8,796,541	614,692	$8,727,372	700,496	$11,985,457
Bituminous rock	25,346	92,238	53,589	262,309	132,353	531,134
Gilsonite	30,848	606,639	(b)	(b)	56,204	548,776
Wurtzilite	(b)	(b)			(b)	(b)
Ozokerite	37	45,399				
Other bituminous substances [c]	3,803	36,532	34,692	420,680	9,940	133,998
	664,757	9,577,349	702,973	9,410,361	898,993	13,199,365

	1921		1922		1923	
Petroleum asphalt [a]	624,220	$9,048,221	805,145	$10,385,925	995,654	$13,060,174
Bituminous rock	284,037	1,788,715	298,047	1,629,440	365,601	2,190,009
Gilsonite	10,066	178,224	29,693	622,107	34,425	681,622
Ozokerite					10	2,000
Wurtzilite	(b)	(b)	(b)	(b)	200	12,000
Other bituminous substances [c]	2,309	18,644	52	1,633		
	920,632	11,033,804	1,132,937	12,639,105	1,395,890	15,945,805

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[a] From domestic petroleum only.
[b] Included under "Other bituminous substances."
[c] 1918, 1920, 1921, and 1922: Grahamite and wurtzilite; 1919: Gilsonite, grahamite, impsonite, and wurtzilite.

Native asphalt and related bitumens sold at mines in the United States, 1918–1923, by States

[Value f. o. b. mine]

State	1918		1919		1920	
	Short tons	Value	Short tons	Value	Short tons	Value
California	3,260	$12,516	[a] 3,614	$15,037	(a b)	(a b)
Oklahoma	(b)	(b)	[c] 4,323	18,187	[c] 7,522	$45,898
Texas	(a b)	(a b)	(a b)	(a b)	(a b)	(a b)
Utah	31,072	663,258	[d] 33,992	406,610	[d] 63,522	659,176
Other States [e]	25,702	105,034	[f] 46,352	243,155	[a] 127,453	508,834
	60,034	780,808	88,281	682,989	198,497	1,213,908

State	1921		1922		1923	
Alabama	-------	-------	-------	-------	[a] 1,200	$4,200
California	(a b)	(a b)	(a b)	(a b)	[a] 2,945	11,780
Kentucky	(a b)	(a b)	(a b)	(a b)	[a] 184,300	1,468,396
Oklahoma	[c] 25,573	$87,587	[c] 47,597	$164,035	[a] 25,800	150,100
Texas	(a b)	(a b)	[a] 152,567	558,274	[a] 151,356	555,533
Utah	[d] 10,371	190,808	[d] 29,704	623,207	[g] 34,635	695,622
Other States [e]	[a] 260,468	1,707,188	[a] 97,924	907,664	-------	-------
	296,412	1,985,583	327,792	2,253,180	400,236	2,885,631

[a] Bituminous rock.

[b] Included under "Other States."

[c] Bituminous rock and grahamite.

[d] Gilsonite and wurtzilite.

[e] 1918: Kentucky, Oklahoma, and Texas; 1919: Illinois, Kentucky, and Texas; 1920 and 1921: California, Kentucky, and Texas; 1922: California and Kentucky.

[f] Bituminous rock, grahamite, and impsonite.

[g] Gilsonite, ozokerite, and wurtzilite.

Asphalt manufactured in the United States from petroleum and sold at refineries, 1919–1923

[Value f. o. b. refinery]

Year	From domestic petroleum		From Mexican petroleum	
	Short tons	Value	Short tons	Value
1919	614,692	$8,727,372	674,876	$7,711,510
1920	700,496	11,985,457	1,045,779	14,272,862
1921	624,220	9,048,221	908,093	11,761,358
1922	805,145	10,385,925	1,242,163	13,899,407
1923	995,654	13,060,174	1,378,722	16,840,045

Asphalt and asphaltic material manufactured in the United States from petroleum and sold at refineries, 1923, by varieties

[Value f. o. b. refinery]

Product	Solid and semisolid products of less than 200 penetration (asphalt)		Semisolid and liquid products of more than 200 penetration (flux [a])		Grand total	
	Short tons	Value	Short tons	Value	Short tons	Value
From domestic petroleum:						
Paving [b]	334,633	$4,873,967	48,223	$492,024	382,856	$5,365,991
Roofing and waterproof [c]	283,121	4,156,921	36,276	449,114	319,397	4,606,035
Mineral rubber [d]	4,313	468,305			4,313	468,305
Road oil [e]			178,329	1,513,436	178,329	1,513,436
Other [f]	28,008	352,495	82,751	753,912	110,759	1,106,407
	650,075	9,851,688	345,579	3,208,486	995,654	13,060,174
From Mexican petroleum:						
Paving [b]	582,972	7,727,242	81,366	771,570	664,338	8,498,812
Roofing and waterproof [c]	406,046	4,804,078	[g] 189,513	[g] 1,900,786	595,559	6,704,864
Mineral rubber [d]	8,046	160,963			8,046	160,963
Road oil [e]			55,217	856,540	55,217	856,540
Other [f]	55,562	618,866	(g)	(g)	55,562	618,866
	1,052,626	13,311,149	326,096	3,528,896	1,378,722	16,840,045

[a] Flux: Liquid asphaltic material used in softening native asphalt or solid petroleum asphalt for paving, roofing, waterproofing, and other purposes.

[b] Paving asphalt: Refined native asphalt and asphaltic cement, fluxed and unfluxed, produced for direct use in the construction of sheet asphalt, asphaltic concrete, asphalt macadam, and asphalt block pavements, and also for use as joint filler in brick, block, and monolithic pavements.

[c] Roofing and waterproofing asphalt: Asphalt and asphaltic cement used in saturating, coating and cementing felt or other fabric and in the manufacture of asphalt shingles.

[d] Mineral rubber: Asphalt and asphaltic cement used by the rubber industry.

[e] Road oil: Residual asphaltic oil used for surface treatment.

[f] Other solid and semisolid products: Asphalt and asphaltic cement used as dips and in the manufacture of insulating materials, acid-resisting compounds, putty, mastic, and briquets and not included in the preceding definitions. Other liquid products: Petroleum asphalt used in the manufacture of saturant, paint, varnish, or other coating, exclusive of fuel oil and not included in the preceding definitions.

[g] Small quantity of miscellaneous liquid products included under roofing and waterproof flux.

IMPORTS AND EXPORTS[1]

Native asphalt and bituminous rock imported into the United States, 1920–1923, by countries

[General imports]

Source	1920		1921		1922		1923	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
North America:								
Canada	88	$2,832	18	$634	52	$2,251	147	$3,358
Mexico	15	66			3	25	3	95
West Indies—								
British—								
Barbados	68	8,128	101	14,760	36	6,590	126	16,260
Trinidad and Tobago	100,783	892,545	75,305	754,503	85,480	721,891	97,252	688,221
Other			896	4,200	1,120	11,200	560	14,850
Cuba	274	7,447	371	7,020	113	2,711	282	7,933
Dominican Republic							15	2,545
South America:								
Argentina							8	768
Colombia	6	207	18	1,556	(a)	5	18	468
Venezuela	27,179	156,282	51,676	343,535	37,449	247,920	37,320	246,572
Europe:								
Belgium			2	30	(a)	3	3	124
Denmark					49	1,516		
France					39	948		
Germany			140	1,889	312	4,481	1,393	18,009
Italy							2	1,010
Netherlands			2	25				
Spain							8	208
Switzerland							(a)	95
United Kingdom—								
England					6	920	7,496	79,145
Ireland	1	109					2	245
Asia:								
Philippine Islands			(a)	5	(a)	2		
Turkey			6	1,133				
	128,414	1,067,616	128,535	1,129,290	124,659	1,000,463	144,635	1,079,906

[a] Figures for quantity not available.

Ozokerite and other mineral waxes imported for consumption in the United States, 1918–1923

Year	Pounds	Value	Year	Pounds	Value
1918	1,809,459	$147,805	1921	8,548,542	$546,054
1919	3,748,080	454,840	1922	8,989,972	371,161
1920	4,272,341	499,758	1923	4,856,357	213,407

Ichthyol and ichthyol substitutes imported for consumption in the United States, 1918–1923

Year	Pounds	Value	Year	Pounds	Value
1918	65,752	$39,452	1921	76,020	$107,752
1919	30,976	38,975	1922	74,330	89,150
1920	98,135	79,133	1923 (see p 135)	20	15

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[1] Statistics of imports and exports compiled by J. A. Dorsey, of the U. S. Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

Asphalt exported from the United States, 1918–1923

Year	Unmanufactured		Manufactures of	Total
	Short tons	Value		
1918	22, 108	$577, 654	$577, 936	$1, 155, 590
1919	40, 208	1, 103, 930	606, 918	1, 710, 848
1920	51, 706	1, 356, 116	842, 074	2, 198, 190
1921	45, 367	1, 178, 038	621, 224	1, 799, 262
1922	57, 362	1, 344, 440	[a] 1, 261, 125	[a] 2, 605, 565
1923	72, 628	1, 500, 869	[a] 2, 075, 628	[a] 3, 576, 497

[a] Inclusive of value of squares (10 by 10 feet) of roofing asphalt as follows: 1922, 588,636 squares, $870,200; 1923, 783,028 squares, $1,124,491. Corresponding exports not separately shown prior to 1922.

Asphalt exported from the United States in 1923, by countries

Country	Unmanufactured		Manufactures of, except roofing	
	Short tons	Value	Short tons	Value
North America:				
Canada	9, 014	$176, 198	2, 607	$83, 254
Central America—				
Costa Rica	----------	----------	(a)	7
Guatemala	----------	----------	(a)	61
Honduras	----------	----------	53	2, 303
Panama	115	2, 818	303	21, 985
Salvador	----------	----------	(a)	2
Mexico	570	10, 136	1, 927	40, 340
Newfoundland and Labrador	----------	----------	2	281
West Indies—				
British—				
Bermuda	----------	----------	29	943
Jamaica	----------	----------	36	1, 542
Other	2	119	4	406
Cuba	927	19, 695	667	32, 035
Dominican Republic	326	9, 634	26	1, 650
Dutch	----------	----------	8	588
French	----------	----------	(a)	81
Haiti	----------	----------	3	543
South America:				
Argentina	438	10, 573	628	21, 721
Bolivia	1	110	(a)	16
Brazil	332	7, 432	546	22, 809
Chile	860	20, 990	191	6, 831
Colombia	11	336	10	619
Ecuador	235	5, 321	----------	----------
Guiana—				
British	----------	----------	1	20
Dutch	----------	----------	1	105
Peru	16	426	75	2, 125
Uruguay	168	12, 421	309	19, 258
Venezuela	1	24	11	999
Europe:				
Belgium	1, 281	29, 658	370	10, 572
Denmark	206	3, 841	58	1, 758
Finland	22	524	5	150
France	5, 292	120, 556	2, 355	50, 697
Germany	2, 218	65, 767	482	14, 168
Greece	25	1, 089	----------	----------
Italy	335	10, 362	143	3, 714
Netherlands	500	14, 636	114	2, 987
Norway	470	8, 397	193	4, 757
Portugal	----------	----------	(a)	150
Spain	2, 329	36, 105	293	7, 542
Sweden	628	12, 443	597	13, 878
Turkey	----------	----------	118	2, 496
United Kingdom—				
England	20, 027	411, 684	10, 581	298, 253
Ireland	338	7, 248	200	5, 800
Scotland	2, 141	47, 287	376	12, 767

[a] Less than 1 ton.

Asphalt exported from the United States in 1923, by countries—Continued

Country	Unmanufactured		Manufactures of, except roofing	
	Short tons	Value	Short tons	Value
Asia:				
China	1,219	$24,147	959	$33,347
East Indies—				
British—				
India	284	8,656	1,761	79,348
Straits Settlements	186	6,495	(a)	19
Other	----------	----------	19	900
Dutch	11	460	22	460
French Indo-China	137	3,054	1	23
Hongkong	836	14,617	96	2,792
Japan	3,161	72,887	677	32,477
Java and Madura	282	8,635	3	220
Kwangtung, leased territory	49	1,066	22	1,668
Palestine and Syria	----------	----------	5	223
Philippine Islands	753	14,193	113	4,730
Siam	11	345	----------	----------
Africa:				
British—				
East	----------	----------	11	940
South	387	12,529	1,004	37,112
Canary Islands	----------	----------	(a)	37
Egypt	34	691	165	5,873
French—				
Algeria and Tunis	----------	----------	1,103	19,269
Other	----------	----------	(a)	26
Morocco	----------	----------	4	91
Portuguese East	31	654	108	2,688
Oceania:				
British—				
Australia	14,309	249,354	806	32,976
New Zealand	2,110	37,256	284	5,705
	72,628	1,500,869	30,485	951,137

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[a] Less than 1 ton.

PRODUCERS

The following operators reported to the United States Geological Survey that they produced asphaltic material from crude petroleum in the United States in 1923:

Atlantic Refining Co., 260 South Broad Street, Philadelphia, Pa.
Byerlyte Co., 2484 West Fourth Street, Cleveland, Ohio.
Craig Oil Co., Toledo, Ohio.
Freeport Gas Co., Freeport, Tex.
Gulf Refining Co., Frick Building Annex, Pittsburgh, Pa.
Harbor Refining Co., 2475 East Ninth Street, Los Angeles, Calif.
Indian Refining Co., Lawrenceville, Ill.
King Refining Co., 255 Holbrook Building, San Francisco, Calif.
Magnolia Petroleum Co., Box 1667, Dallas, Tex.
Mexican Petroleum Corporation, 120 Broadway, New York, N. Y.
Paraffine Companies (Inc.), 475 Brennan Street, San Francisco, Calif.
Pioneer Asphalt Co., Lawrenceville, Ill.
Pioneer Paper Co., 247 South Los Angeles Street, Los Angeles, Calif.
Producers Refining Co., Bakersfield, Calif.
Seaside Oil Co., Summerland, Calif.
Sinclair Refining Co. of Louisiana, 45 Nassau Street, New York, N. Y.
Standard Oil Co. of California, 200 Bush Street, San Francisco, Calif.
Standard Oil Co. of Indiana, 910 South Michigan Avenue, Chicago, Ill. (plants in Illinois, Indiana, and Missouri).
Standard Oil Co. of Louisiana, Baton Rouge, La.
Standard Oil Co. of New Jersey, 26 Broadway, New York, N. Y.
Sun Co., Finance Building, Philadelphia, Pa.
Texas Co., Houston, Tex.
Union Oil Co. of California, A. G. Bartlett Building, Los Angeles, Calif.
United States Asphalt Refining Co., 90 West Street, New York, N. Y.
Warner Quinlan Asphalt Co., 79 Wall Street, New York, N. Y.

Native asphalt and related bitumens were produced commercially in this country in 1923 by the following operators:

Alabama Rock Asphalt Co., Florence, Ala.
American Asphalt Association, 918 Wainwright Building, St. Louis, Mo.
City Street Improvement Co., 400 California Street, San Francisco, Calif.
Continental Rock Asphalt Co., Dwight Building, Kansas City, Mo.
Crown Rock Asphalt Co., 911 Neave Building, Cincinnati, Ohio.
Ferron, Fred, Duchesne, Utah.
Gilson Asphaltum Co., 1900 Land Title Building, Philadelphia, Pa.
Glafcke, Ludlow B., Dooly Block, Salt Lake City, Utah.
Kentucky Rock Asphalt Co., 712 Paul Jones Building, Louisville, Ky.
Natural Rock Asphalt Corporation, Owensboro, Ky.
Ohio Valley Rock Asphalt Co., 1403 Starks Building, Louisville, Ky.
Sattler & Stevens, Carpinteria, Calif.
Texas Rock Asphalt Co., San Antonio, Tex.
Utah Gilsonite Co., Watson, Utah.
Uvalde Rock Asphalt Co., San Antonio, Tex.

MICA

By B. H. Stoddard

PRODUCTION

The domestic mica industry in 1923 showed substantial increases over 1922 in quantity and value of both sheet and scrap mica sold by producers during the year, the total quantity of sheet mica sold being 2,063,179 pounds (1,032 short tons), valued at $311,180, and of scrap mica (which includes some derived from mica schist) 8,054 short tons, valued at $129,695. The total quantity and value of all mica sold represents increases of 27 and 43 per cent, respectively. Sales of sheet mica showed increases of 91 per cent in quantity and 60 per cent in value. Scrap mica, the quantity of which was the largest ever recorded, showed increases over 1922 of 21 per cent in quantity and 14 per cent in value. The average value of sheet mica was 15 cents a pound, against 18 cents in 1922, and the average value of scrap mica was $16 a short ton, against $17 in 1922. North Carolina and New Hampshire reported 95 per cent of the total quantity of sheet mica and 76 per cent of the scrap mica sold in 1923.

The figures for sheet mica shown in the following table represent uncut sheet mica and punch mica. A very small quantity of splittings is also included as uncut sheet.

Mica sold by producers in the United States, 1919–1923

Year	Sheet mica		Scrap mica		Total	
	Pounds	Value	Short tons	Value	Short tons	Value
1919	[a] 1,545,709	[a] $483,567	3,258	$58,084	[a] 4,031	[a] $541,651
1920	1,683,480	546,972	5,723	167,017	6,565	713,989
1921	741,845	118,513	2,577	56,849	2,948	175,362
1922	1,077,968	194,301	[b] 6,641	114,045	[b] 7,180	308,346
1923	2,063,179	311,180	[b] 8,054	129,695	[b] 9,086	440,875

[a] The figures for sheet mica in 1920–1923 are not strictly comparable with those for earlier years, as they represent uncut sheet mica exclusively. Prior to 1920 some cut sheet mica was included.

[b] Includes mica derived from mica schist.

The sales were made by producers in 11 States—North Carolina, New Hampshire, New Mexico, Virginia, South Dakota, Wyoming, Georgia, Colorado, Connecticut, South Carolina, and New York, named in order of total quantity of mica sold.

Domestic mica sold by producers in certain States, 1919–1923

Year	Sheet mica			Scrap mica		Total	
	Pounds	Short tons	Value	Short tons	Value	Short tons	Value
North Carolina:							
1919	1, 021, 306	511	$331, 498	1, 639	$32, 338	2, 150	$363, 836
1920	1, 084, 946	542	405, 654	2, 823	91, 653	3, 365	497, 307
1921	230, 532	115	51, 851	1, 353	30, 496	1, 468	82, 347
1922	544, 495	272	119, 767	[a] 4, 205	65, 923	[a] 4, 477	185, 690
1923	1, 130, 283	565	188, 317	[a] 5, 005	65, 764	[a] 5, 570	254, 081
New Hampshire:							
1919	235, 724	118	90, 915	738	13, 356	856	104, 271
1920	284, 862	142	83, 811	435	12, 877	577	96, 688
1921	491, 743	246	63, 249	537	10, 613	783	73, 862
1922	475, 647	238	63, 240	238	5, 838	476	69, 078
1923	835, 751	418	107, 674	1, 078	25, 871	1, 496	133, 545
Virginia:							
1919	([b])	([b])	([b])	578	7, 811	([b])	([b])
1920	179, 339	90	26, 189	([b])	([b])	([b])	([b])
1921	([b])	([b])	([b])	([b])	([b])	([b])	([b])
1922	43, 449	22	6, 577	296	9, 718	318	16, 295
1923	([b])	([b])	([b])	([b])	([b])	([b])	([b])
Georgia:							
1919	47, 018	24	19, 682	51	778	75	20, 460
1920	50, 095	25	13, 692	101	3, 015	126	16, 707
1921	12, 730	6	2, 640	75	1, 700	81	4, 340
1922	8, 818	4	4, 083	224	7, 247	228	11, 330
1923	([b])	([b])	([b])	([b])	([b])	([b])	([b])

[a] Includes mica derived from mica schist.
[b] The figures are not given, as there were less than three producers.

Sales in New Mexico greatly exceeded those in 1922, being 30,300 pounds of sheet mica, valued at $8,489, and 898 short tons of scrap mica, valued at $16,417. In 1923 South Dakota sold 324 short tons of scrap mica, valued at $6,480. Sales in the other States—Colorado, Connecticut, New York, South Carolina, and Wyoming—were comparatively small.

CLASSIFICATION OF MICA

Mica is valuable in sheet form and as scrap suitable for grinding into a powder. For commercial sheet mica the individual pieces must be large enough to contain a rectangular area measuring at least 1½ by 2 inches, which must split easily and evenly and be nearly free from "cracks," "rulings," "markings," and all fracture lines and reasonably free from inclusions or specks of foreign mineral matter. The size stated is the smallest rectangular size that is salable in the form of uncut sheet; the irregularly bounded rough-trimmed mica sheet must be nearly twice as large to yield this size—in other words, a sheet that would yield a suitable rectangle 1½ by 2 inches and would be classed as "1½ by 2 inches" would have to measure nearly 3 by 4 inches.

Splittings are the thin films or flakes of mica that are split from the smaller sheet or waste material. They are about one-thousandth of an inch thick and are irregular in shape.

Material suitable as scrap mica for grinding must be free from all foreign matter, especially gritty material such as quartz and feldspar.

The system of classification of mica, by sizes, is different in the United States, Canada, and India. The United States classification is as follows (figures represent inches): Punch, circle, 1½ by 2, 2 by 2, 2 by 3, 3 by 4, 3 by 5, 4 by 6, 6 by 6, 6 by 8, 8 by 10, and larger.

For punch mica the uncut sheet must be of sufficient size to yield a circle 1½ inches in diameter if stained and 1¼ inches if clear; circle mica should yield a disk nearly 2 inches in diameter.

Canadian or "amber" mica is also classified on the basis of the size of the rectangle obtainable, but the sizes differ from those used for the United States mica. The sizes used for Canadian mica, in inches, are 1 by 1, 1 by 2, 1 by 3, 2 by 3, 2 by 4, 3 by 5, 4 by 6, and 5 by 8.

The Indian classification is not based on the size of the rectangle obtainable but on the area of usable mica in the sheet. The following table shows the Indian system of grading, with the approximate corresponding sizes used in the United States classification:

Grading of Indian mica

Grade	Area of usable mica (in square inches), based on rectangular sizes	Sizes of rectangles that can be cut (in inches)				Approximate corresponding sizes in United States classification (in inches)
		Width		Length		
		Minimum	Maximum	Minimum	Maximum	
6	Less than 3					Punch.
5	3 to 5⅞	1	2	2	2½	2 by 2.
4	6 to 9⅞	1½	2½	2½	3	2 by 3. 3 by 3.
3	10 to 14⅞	1½	3	3	4½	3 by 4.
2	15 to 23⅞	1½	3½	4½	6	3 by 5.
1	24 to 35⅞	3	5	5	7	4 by 6.
A-1	36 to 47⅞	4	6	7	9	5 by 8.
Special	48 to 59⅞					6 by 8.
Extra special	60 to 71⅞					8 by 8.
Extra extra special	72 and more					8 by 10.

In the following table about 80 per cent of the total quantity of uncut sheet mica sold in 1923 has been classified to show the qualities of mica and the average value by sizes. It was not possible to classify a larger percentage, for the reason that some of the reports received by the Geological Survey did not contain this information. Several of the larger companies have sent in returns in great detail, but others have not done so, owing in part to the fact that some mica is not sold by the miner in sheet form classified by sizes and also to the fact that some of the companies either do not keep an accurate account of the mica they handle or do not wish to furnish the figures.

Clear and stained uncut rough-trimmed sheet mica produced in the United States and sold in 1923, by sizes

[Shows about 80 per cent of the total for the United States]

Size	Clear			Stained			Total	
	Pounds	Value		Pounds	Value		Pounds	Percentage
		Total	Average		Total	Average		
Punch or washer	524, 079	$66, 117	$0. 13	894, 752	$57, 037	$0. 06	1, 418, 831	86. 4
Circle				38, 431	3, 361	. 09	38, 431	2. 3
1½ by 2 inches	49, 591	8, 518	. 17	3, 392	457	. 13	52, 983	3. 2
2 by 2 inches	33, 866	13, 999	. 41	7, 078	1, 052	. 15	40, 944	2. 5
2 by 3 inches	36, 582	25, 755	. 70	5, 553	2, 284	. 41	42, 135	2. 6
3 by 3 inches	13, 948	18, 440	1. 32	2, 132	1, 637	. 77	16, 080	1. 0
3 by 4 inches	9, 536	16, 840	1. 77	1, 863	2, 262	1. 21	11, 399	. 7
3 by 5 inches	12, 544	27, 249	2. 17	2, 049	3, 154	1. 54	14, 593	. 9
4 by 6 inches	6, 340	19, 025	3. 00	1, 247	2, 798	2. 24	7, 587	. 4
	686, 486	195, 943	. 29	956, 497	74, 042	. 08	1, 642, 983	100. 0

Value of mica sold by producers in the United States, 1919–1923[a]

Year	Total	Average	
		Sheet and scrap (per short ton)	Sheet (per pound)
1919	$541, 651	$134	$0. 31
1920	713, 989	109	. 32
1921	175, 362	59	. 16
1922	308, 346	43	. 18
1923	440, 875	49	. 15

[a] The figures for sheet mica in 1920–1923 are not strictly comparable with those for earlier years, as they represent uncut sheet mica exclusively. Prior to 1920 some cut sheet mica was included.

Mica prices during 1923 on the whole showed small variation. The prices for the smaller sizes of sheet mica tended to decrease in the last half of the year, while the prices for the sizes larger than 2 by 2 inches showed varying increases for the same period. In the first half of 1924 prices of uncut sheet mica were slightly higher than for the preceding six months and were more stable.

WORLD'S PRODUCTION[1]

World's production of mica, 1914–1923, in metric tons

Country [a]	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
North America:										
Canada	540	378	1, 096	1, 058	678	2, 498	1, 999	637	3, 038	2, 368
United States	3, 636	3, 843	4, 414	3, 690	2, 825	3, 657	5, 956	2, 674	6, 514	8, 243
South America:										
Argentina [b]	(c)	-------	6	63	172	52	65	7	8	(d)
Brazil [b]	18	51	54	96	162	154	68	46	67	56
Europe:										
Norway [b]	33	21	24	39	66	96	31	2	1	(d)
Rumania	-------	-------	-------	-------	-------	72	135	-------	-------	(d)
Russia	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	8	(d)
Spain	-------	-------	-------	-------	8	7	5	2	-------	-------
Sweden	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	8	(d)
Asia:										
Ceylon [b]	12	26	-------	-------	6	8	13	5	1	1
Chosen	(d)	(d)	(d)	(d)	(d)	(d)	(d)	11	19	(d)
India (British)	2, 058	1, 379	2, 205	2, 078	2, 778	2, 326	2, 385	1, 650	1, 604	(d)
Africa:										
Madagascar [b]	3	1	3	(c)	4	19	49	141	92	165
Nyasaland [b]	5	4	1	-------	4	(d)	(d)	(d)	(d)	(d)
Rhodesia	-------	-------	-------	-------	-------	5	89	77	60	82
Tanganyika Territory [b]	46	(d)	(d)	(d)	[e] 17	[e] 131	27	3	11	(d)
Union of South Africa (Transvaal)	-------	2	12	4	5	3	1	1	3	15
Oceania:										
Australia—										
Northern Territory	-------	-------	-------	-------	-------	1	4	1	1	(d)
Queensland	-------	-------	-------	-------	-------	-------	-------	-------	(c)	-------
South Australia	-------	-------	-------	38	-------	-------	-------	-------	-------	-------
Western Australia [b]	4	[f] 3	[f] 1	-------	-------	1	(c)	-------	2	(d)

[a] Sources of information—Canada: 1914–1920, Dept. Mines, Mines Branch, Ann. Repts.; 1921, Dominion Bur. Statistics, Ann. Rept.; 1922–1923, Dominion Bur. Statistics, Prel. Repts. Argentina: 1914–1918, Estadística minera; 1919–1922, data furnished by Dirección general de minas, geología é hidrología. Brazil: Commercio exterior do Brasil. Norway: Norges Handel. Rumania: Statistique minière de la Roumanie. Russia: Gornyi Zhurnal, Nos. 3–4, 1923, Moscow. Spain: Estadística minera de España. Sweden: Sveriges officiella Statistik, Bergshantering. Ceylon: 1914–1915, Bull. mines de Madagascar; 1916–1918, Imp. Mineral Resources Bur., London; 1919–1923, official data furnished by U. S. consul, Colombo, Ceylon. Chosen: Official data furnished by U. S. consul, Keijo, Chosen. India: Geol. Survey Records. Madagascar: 1914–1921, Rapport, Service des mines; 1922–1923, Bull. des mines, Tananarive. Nyasaland: Imp. Mineral Resources Bur., London. Rhodesia: Sec. Mines Rept. Southern Rhodesia: Chamber of Mines Rept. Tanganyika Territory: Imp. Mineral Resources Bur., London. Union of South Africa: Sec. Mines Ind., Dept. Mines, Ind., Ann. Repts. Australia: Northern Territory, Dept. Mines. Queensland: Under Sec. Mines, Ann. Rept. South Australia: Review of mining operations, Dept. Mines. Western Australia: Dept. Mines, Rept.

[b] Exports.

[c] Less than ½ ton.

[d] Data not available.

[e] From early in 1917 to July, 1918, the Uluguru mines were worked by a mica board under military authorities; 17 tons was exported by the mica board. From July, 1918, to March 31, 1920, the civil administration, operating under a mica expert, exported 131 tons.

[f] Estimate by U. S. Geol. Survey based on value reported.

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[1] Compiled by Miss W. I. Whiteside, of the United States Geological Survey.

World's production of sheet mica, 1914–1923, in metric tons

Year	United States	India	Canada [a]	Other countries [b]	Total	Percentage of total in United States
1914	253	2,058	270	121	2,702	9
1915	251	1,379	189	108	1,927	13
1916	393	2,205	548	101	3,247	12
1917	579	2,078	529	240	3,426	17
1918	746	2,778	339	444	4,307	17
1919	701	2,326	1,249	549	4,825	15
1920	764	2,385	1,000	487	4,636	16
1921	337	1,650	180	296	2,463	14
1922	489	1,604	179	281	2,553	19
1923	936	(c)	399	319	(c)	(c)

[a] 1914–1920, estimated, by U. S. Geol. Survey as one-half of the total reported production of mica in Canada; 1921–1923, figures for sheet mica as published by Dominion Bureau of Statistics.
[b] The total reported production of mica for the other countries incomplete, as no figures of production are available for some of the countries.
[c] Figures not yet available.

IMPORTS AND EXPORTS[2]

The imports of uncut sheet mica in 1923 were 1,044,366 pounds, valued at $532,375. Imports of mica in 1923 were received from 19 countries.

Mica imported for consumption in the United States, 1920–1923

Kind	1920		1921		1922		1923	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured [a]	1,298,537	$1,177,943	328,444	$331,219	385,653	$359,793	1,044,366	$532,375
Cut and split [b]	(c)	2,011,434	(c)	758,521	(c)	[d] 555,243	(d)	(d)
Ground	----------	----------	134,650	2,166	313,745	4,514	1,867,385	28,324
Cut mica (dimension sheets)	(f)	(f)	(f)	(f)	[e] 42,579	[e] 18,372	60,135	49,268
Splittings					[e] 1,063,306	[e] 371,801	4,301,727	1,730,532
Built-up mica boards, cups, tubes, and mica plates					[e] 1,807	[e] 2,860	30,032	37,382
Washers					[e] 2,562	[e] 675	20,164	6,776
Other manufactures					[e] 7,842	[e] 17,364	7,044	20,191
	----------	3,189,377	----------	1,091,906	----------	1,330,622	7,330,853	2,404,848

[a] Essentially uncut trimmed sheets.
[b] Includes the Madras square-shaped uncut sheets.
[c] Quantities not recorded prior to new tariff, Sept. 22, 1922.
[d] Classification discontinued with new tariff and items shown separately.
[e] Sept. 22–Dec. 31.
[f] Not separately classified prior to new tariff.

The import duty on mica as fixed by the tariff act of September 22, 1922, paragraph 208, is as follows:

> Mica, unmanufactured, valued at not above 15 cents per pound, 4 cents per pound, valued above 15 cents per pound, 25 per centum ad valorem; mica cut or trimmed and mica splittings, 30 per centum ad valorem; mica plates, and built-up mica, and all manufactures of mica or of which mica is the component material of chief value, 40 per centum ad valorem; ground mica, 20 per centum ad valorem.

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[2] The statistical information on imports and exports has been compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, United States Department of Commerce.

Mica imported into the United States in 1922 and 1923, by countries

[General imports]

Country	Unmanufactured		Cut, split, and manufactured [a]	
	Pounds	Value	Pounds	Value
1922				
Africa:				
British South	6,901	$2,737		$1,036
Portuguese East	1,896	813		
Argentina	62,253	41,781		1,915
Brazil	68,796	73,904		3,929
Canada	343,127	36,859		335,588
Ceylon	3,919	8,381		
China				1,411
Czechoslovakia				55
England	106,863	120,806		73,643
France	854	953		1,016
Germany	104	62		137
Guatemala	627	678		1,501
Hongkong				68
India (British)	53,925	70,765		584,951
Mexico				579
Nicaragua				113
Scotland	620	2,457		
Switzerland				14,033
	649,885	360,196		1,019,975
1923				
Africa:				
British South	9,793	5,942	3,872	1,550
Portuguese East	12,257	9,869	922	444
Argentina	102,063	54,188	90	66
Brazil	66,571	56,743	2,680	783
Canada	476,300	58,614	2,604,096	604,447
Ceylon	7,708	9,385		
Chile	110	424		
China			30	59
England	141,082	146,121	269,945	71,931
France	48,362	37,309	1,818	3,596
Germany	2,826	4,341	15,424	15,115
Guatemala	2,690	1,544	11,629	5,139
Hongkong			6	3
India (British)	142,194	119,121	3,250,581	1,128,649
Jamaica			265	93
Mexico			3,400	1,303
Scotland	5,756	6,116		
Switzerland			5,155	11,342
Venezuela			1,166	59
	1,017,712	509,717	6,171,079	1,844,579

[a] Quantities not recorded prior to new tariff, Sept. 22, 1922.

Figures showing the consumption of mica splittings in 1923 are incomplete, as some of the companies did not report this information.

Mica and manufactures of mica were exported to 46 countries in 1923, but about 88 per cent of the total quantity, which was 1,804,342 pounds, went to Canada, England, and France, in the order named. The total value of the mica exported was $182,162, against $129,186 in 1922.

SAND AND GRAVEL

By A. T. Coons

PRODUCTION

The sand and gravel sold or used by the producers in the United States in 1923 amounted to 139,932,153 short tons and was valued at $90,903,654. These figures show an increase of about 48 per cent in quantity and 41 per cent in value over those for 1922. There was a general increase in both the quantity and the value of all classes of this material except in the value for filter sand. A special canvass of railroad companies was made in 1923 in order to obtain more complete reports of noncommercial material used by them, and the figures obtained make up in part the large increase (146 per cent) shown in the quantity of gravel for railroad ballast. The sand and gravel for use in the construction of buildings and pavements also showed a large increase. Sand for molding increased 45 per cent. The figures for 1923 include returns obtained from 2,428 sand and gravel plants, which is 443 more than the number represented by the figures for 1922.

The production of sand and gravel reported for 1923 is approximately double that for 1919.

Sand and gravel sold or used by the producers in the United States, 1919–1923

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	35, 969, 736	$26, 389, 679	34, 606, 671	$19, 561, 877	70, 576, 407	$45, 951, 556
1920	43, 776, 142	39, 198, 614	38, 265, 246	26, 462, 991	82, 041, 388	65, 661, 605
1921	38, 294, 954	[a] 29, 049, 950	41, 550, 054	27, 434, 295	79, 845, 008	56, 484, 245
1922	49, 694, 923	35, 469, 920	45, 172, 123	29, 147, 744	94, 867, 046	64, 617, 664
1923	67, 365, 271	48, 473, 565	72, 566, 882	42, 430, 089	139, 932, 153	90, 903, 654
Per cent of increase in 1923 over 1922	36	37	61	46	48	41

[a] Revised figures.

Sand and gravel sold or used by the producers in the United States in 1922 and 1923, by uses

Use	1922		1923	
	Short tons	Value	Short tons	Value
Sand:				
Glass	1, 768, 549	$2, 866, 366	2, 034, 958	$3, 751, 778
Molding	3, 839, 116	4, 478, 405	5, 559, 644	6, 730, 417
Building	29, 375, 466	17, 574, 579	39, 234, 762	23, 751, 244
Paving	10, 669, 772	6, 481, 601	15, 632, 419	9, 187, 468
Grinding and polishing	1, 183, 161	1, 732, 469	1, 456, 039	2, 361, 695
Fire or furnace	237, 065	336, 085	307, 794	445, 479
Engine	1, 685, 712	1, 288, 022	2, 033, 494	1, 535, 638
Filter	71, 728	142, 692	116, 520	139, 671
Other	864, 354	569, 701	989, 641	570, 175
	49, 694, 923	35, 469, 920	67, 365, 271	48, 473, 565
Gravel:				
Building	18, 686, 176	14, 541, 169	24, 145, 463	18, 367, 713
Paving	17, 432, 445	11, 373, 712	26, 174, 112	17, 716, 779
Railroad ballast	9, 053, 502	3, 232, 863	22, 247, 307	6, 345, 597
	45, 172, 123	29, 147, 744	72, 566, 882	42, 430, 089
Grand total	94, 867, 046	64, 617, 664	139, 932, 153	90, 903, 654

Sand and gravel sold or used by the producers in the United States in 1922 and 1923, by States

State	Plants reporting	Sand		Gravel		Total	
		Short tons	Value	Short tons	Value	Short tons	Value
1922							
Alabama	14	443, 180	$217, 377	405, 563	$129, 543	848, 743	$346, 920
Arizona	3	[a] 144, 674	[a] 101, 252	[a] 238, 130	[a] 178, 598	386, 854	283, 600
Arkansas	23	229, 761	209, 329	610, 012	312, 792	839, 773	522, 121
California	77	3, 126, 844	2, 113, 340	2, 820, 048	1, 920, 516	5, 946, 892	4, 033, 856
Colorado	12	65, 426	35, 948	73, 939	78, 703	139, 365	114, 651
Connecticut	17	235, 252	130, 963	90, 246	68, 297	325, 498	199, 260
Delaware	5	32, 492	30, 561	----------	----------	32, 492	30, 561
District of Columbia	1	(b)	(b)	(b)	(b)	(b)	(b)
Florida	9	[a] 173, 349	[a] 101, 169	[a] 20, 100	[a] 12, 655	246, 849	147, 924
Georgia	23	454, 117	186, 020	7, 242	5, 400	461, 359	191, 420
Hawaii	1	----------	----------	10, 131	3, 300	10, 131	3, 300
Idaho	4	45, 840	17, 915	33, 811	20, 860	79, 651	38, 775
Illinois	165	4, 917, 379	3, 325, 897	3, 922, 914	2, 085, 924	8, 840, 293	5, 411, 821
Indiana	98	2, 414, 558	1, 166, 437	3, 409, 772	1, 810, 571	5, 824, 330	2, 977, 008
Iowa	102	1, 313, 324	721, 015	1, 377, 474	1, 031, 218	2, 690, 798	1, 752, 233
Kansas	22	1, 358, 426	776, 808	40, 570	13, 955	1, 398, 996	790, 763
Kentucky	27	641, 320	488, 367	876, 439	449, 282	1, 517, 759	937, 649
Louisiana	16	342, 357	175, 610	1, 368, 935	931, 197	1, 711, 292	1, 106, 807
Maine	10	55, 177	48, 157	45, 002	54, 744	100, 179	102, 901
Maryland	20	898, 474	703, 002	688, 441	903, 374	1, 586, 915	1, 606, 376
Massachusetts	50	850, 166	745, 782	750, 415	753, 388	1, 600, 581	1, 499, 170
Michigan	172	1, 971, 237	1, 021, 500	3, 991, 679	2, 200, 543	5, 962, 916	3, 222, 043
Minnesota	54	900, 033	535, 786	1, 000, 499	796, 781	1, 900, 532	1, 332, 567
Mississippi	16	171, 144	92, 110	1, 616, 353	789, 373	1, 787, 497	881, 483
Missouri	41	1, 167, 569	756, 454	802, 776	306, 916	1, 970, 345	1, 063, 370
Montana	10	15, 997	12, 859	63, 607	43, 260	79, 604	56, 119
Nebraska	32	832, 733	308, 748	680, 524	496, 467	1, 513, 257	805, 215
Nevada	6	14, 256	2, 015	264, 100	87, 976	278, 356	89, 991
New Hampshire	9	146, 797	108, 715	295, 712	249, 185	442, 509	357, 900
New Jersey	82	3, 663, 386	2, 537, 726	1, 191, 047	887, 287	4, 854, 433	3, 425, 013
New Mexico	4	[a] 46, 285	[a] 29, 068	[a] 187, 365	[a] 109, 218	244, 315	146, 670
New York	139	[a] 5, 954, 439	[a] 3,543, 760	[a] 2,310, 725	[a] 1,508, 725	8, 303, 392	5, 085, 312
North Carolina	13	300, 605	130, 122	464, 335	504, 802	764, 940	634, 924
North Dakota	1	(b)	(b)	----------	----------	(b)	(b)
Ohio	155	4, 118, 429	3, 644, 153	2, 881, 533	1, 859, 221	6, 999, 962	5, 503, 374
Oklahoma	28	[a] 747, 663	[a] 484, 959	[a] 585, 643	[a] 408, 498	1, 357, 272	903, 043
Oregon	32	551, 134	485, 908	973, 693	692, 370	1, 524, 827	1, 178, 278
Pennsylvania	170	4, 879, 880	5, 571, 598	2, 473, 108	1, 842, 088	7, 352, 988	7, 413, 686
Rhode Island	3	12, 106	17, 161	335	500	12, 441	17, 661
South Carolina	9	216, 568	122, 249	206, 182	175, 649	422, 750	297, 898
South Dakota	16	110, 432	75, 602	89, 976	46, 088	200, 408	121, 690

[a] Exclusive of small amounts of material included under "Undistributed" to avoid disclosing confidential information.

[b] Included under "Undistributed."

Sand and gravel sold or used by the producers in the United States in 1922 and 1923, by States—Continued

State	Plants reporting	Sand		Gravel		Total	
		Short tons	Value	Short tons	Value	Short tons	Value
1922—Continued							
Tennessee	26	941, 605	$770, 675	629, 887	$422, 458	1, 571, 492	$1, 193, 133
Texas	37	554, 909	375, 201	2, 384, 196	1, 354, 845	2, 939, 105	1, 730, 046
Utah	8	85, 682	38, 944	326, 862	113, 525	412, 544	152, 469
Vermont	11	59, 668	18, 165	4, 421	1, 130	64, 089	19, 295
Virginia	35	752, 837	501, 816	817, 938	831, 625	1, 570, 775	1, 333, 441
Washington	36	592, 796	255, 052	1, 209, 325	589, 200	1, 802, 121	844, 252
West Virginia	26	1, 051, 573	1, 539, 620	502, 356	524, 161	1, 553, 929	2, 063, 781
Wisconsin	109	1, 636, 628	855, 721	1, 797, 368	1, 101, 903	3, 433, 996	1, 957, 624
Wyoming	6	20, 094	13, 588	308, 307	80, 982	328, 401	94, 570
Undistributed	--------	436, 322	325, 696	323, 087	358, 651	629, 100	595, 700
	1, 985	49, 694, 923	35, 469, 920	45, 172, 123	29, 147, 744	94, 867, 046	64, 617, 664
1923							
Alabama	22	743, 494	309, 355	1, 086, 065	450, 881	1, 829, 559	760, 236
Arizona	1	([b])	([b])	([b])	([b])	([b])	([b])
Arkansas	21	345, 968	266, 966	1, 226, 272	559, 338	1, 572, 240	826, 304
California	109	3, 666, 411	2, 464, 433	3, 539, 105	2, 569, 024	7, 205, 516	5, 033, 457
Colorado	10	[a] 113, 241	[a] 75, 368	[a] 39, 569	[a] 43, 046	185, 994	126, 967
Connecticut	25	[a] 282, 231	[a] 179, 838	[a] 392, 390	[a] 120, 783	691, 039	303, 443
Delaware	6	53, 022	34, 113	------------	------------	53, 022	34, 113
District of Columbia	1	([b])	([b])	([b])	([b])	([b])	([b])
Florida	10	394, 165	216, 702	119, 080	73, 380	513, 245	290, 082
Georgia	30	487, 781	233, 978	107, 336	66, 643	595, 117	300, 621
Hawaii	1	------------	------------	([b])	([b])	([b])	([b])
Idaho	7	5, 781	3, 296	91, 263	39, 743	97, 044	43, 039
Illinois	177	6, 812, 867	4, 824, 694	5, 138, 178	2, 636, 044	11, 951, 045	7, 460, 738
Indiana	128	3, 533, 755	1, 801, 920	7, 384, 523	3, 188, 586	10, 918, 278	4, 990, 506
Iowa	109	1, 832, 333	965, 276	1, 764, 827	1, 216, 605	3, 597, 160	2, 181, 881
Kansas	35	1, 688, 370	883, 234	262, 041	155, 830	1, 950, 411	1, 039, 064
Kentucky	31	781, 537	600, 022	1, 320, 303	679, 419	2, 101, 840	1, 279, 441
Louisiana	29	727, 790	346, 070	2, 177, 819	1, 580, 847	2, 905, 609	1, 926, 917
Maine	23	73, 894	40, 195	458, 043	129, 710	531, 937	169, 905
Maryland	23	[a]1, 207, 723	[a]1, 033, 722	[a] 834, 617	[a]1, 121, 201	2, 044, 490	2, 155, 353
Massachusetts	56	1, 087, 809	916, 999	725, 906	904, 117	1, 813, 715	1, 821, 116
Michigan	201	3, 436, 049	1, 924, 400	6, 165, 513	3, 171, 671	9, 601, 562	5, 096, 071
Minnesota	79	1, 309, 895	760, 864	2, 516, 577	1, 423, 242	3, 826, 472	2, 184, 106
Mississippi	23	190, 230	88, 174	2, 581, 919	1, 141, 635	2, 772, 149	1, 229, 809
Missouri	47	1, 954, 385	1, 197, 501	1, 764, 858	810, 028	3, 719, 243	2, 007, 529
Montana	16	26, 248	32, 665	339, 055	123, 392	365, 303	156, 057
Nebraska	33	1, 048, 965	362, 640	881, 139	558, 793	1, 930, 104	921, 433
Nevada	4	23, 164	2, 085	246, 160	54, 853	269, 324	56, 938
New Hampshire	6	151, 062	125, 541	354, 001	298, 313	505, 063	423, 854
New Jersey	98	4, 594, 826	3, 224, 337	1, 506, 378	1, 157, 518	6, 101, 204	4, 381, 855
New Mexico	4	[a] 74, 209	[a] 47, 095	[a] 78, 204	[a] 63, 681	464, 410	239, 470
New York	167	7, 291, 594	4, 646, 981	3, 438, 631	2, 644, 095	10, 730, 225	7, 291, 076
North Carolina	16	742, 432	246, 083	1, 310, 485	1, 168, 456	2, 052, 917	1, 414, 539
North Dakota	2	([b])	([b])	([b])	([b])	([b])	([b])
Ohio	169	5, 849, 091	5, 418, 645	4, 277, 886	2, 444, 730	10, 126, 977	7, 863, 375
Oklahoma	39	754, 025	530, 666	650, 160	443, 795	1, 404, 185	974, 461
Oregon	36	593, 564	490, 061	1, 108, 875	830, 422	1, 702, 439	1, 320, 483
Pennsylvania	188	6, 438, 366	7, 791, 643	2, 782, 926	2, 152, 376	9, 221, 292	9, 944, 019
Rhode Island	5	21, 459	31, 379	48, 255	4, 994	69, 714	36, 373
South Carolina	12	249, 750	94, 478	331, 298	241, 631	581, 048	336, 109
South Dakota	26	123, 830	69, 876	180, 938	87, 038	304, 768	156, 914
Tennessee	33	902, 733	663, 985	965, 604	589, 099	1, 868, 337	1, 253, 084
Texas	76	1, 135, 537	571, 067	3, 924, 064	1, 999, 927	5, 059, 601	2, 570, 994
Utah	15	151, 748	65, 793	1, 060, 329	225, 014	1, 212, 077	290, 807
Vermont	10	[a] 14, 766	[a] 4, 320	[a] 7, 775	[a] 1, 773	55, 551	18, 793
Virginia	38	1, 108, 855	614, 183	1. 085, 006	1, 051, 256	2, 193, 861	1, 665, 439
Washington	51	827, 526	403, 876	2, 961, 583	959, 130	3, 789, 109	1, 363, 006
West Virginia	33	1, 521, 469	2, 308, 819	916, 131	891, 829	2, 437, 600	3, 200, 648
Wisconsin	131	2, 556, 020	1, 283, 780	2, 465, 588	1, 510, 219	5, 021, 608	2, 793, 999
Wyoming	16	164, 509	83, 732	1, 212, 762	320, 179	1, 377, 271	403, 911
Undistributed	--------	270, 792	192, 715	737, 445	525, 803	611, 478	565, 319
	2, 428	67, 365, 271	48, 473, 565	72, 566, 882	42, 430, 089	139, 932, 153	90, 903, 654

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[a] Exclusive of small amounts of material included under "Undistributed" to avoid disclosing confidential information.
[b] Included under "Undistributed."

Sand and gravel sold or used by the producers in the United States in 1923, by States and uses

State	Glass sand		Molding sand		Building sand		Grinding and polishing sand		Fire or furnace sand		Engine sand		Paving sand	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			40, 138	$19, 413	658, 706	$265, 642	(a)	(a)			3, 000	$1, 800	40, 500	$21, 750
Arizona							(a)	(a)						
Arkansas	(a)	(a)	(a)	(a)	151, 065	111, 061					35, 597	16, 856	89, 493	61, 479
California	(a)	(a)	29, 547	58, 254	2, 748, 229	1, 819, 455	1, 356	$4, 409	(a)	(a)	27, 890	14, 152	738, 254	512, 500
Colorado			41	35	38, 330	19, 739					37, 186	26, 847	37, 684	28, 747
Connecticut			2, 592	2, 694	249, 035	143, 916					(a)	(a)	30, 238	32, 670
Delaware			11, 513	14, 081	6, 260	5, 001	(a)	(a)	(a)	(a)	9, 708	2, 427	20, 676	8, 814
District of Columbia					(a)	(a)							(a)	(a)
Florida					295, 145	160, 012					3, 120	1, 440	95, 900	55, 250
Georgia	(a)	(a)	49, 045	22, 211	377, 795	180, 415	1, 265	701			19, 995	5, 913	(a)	(a)
Hawaii														
Idaho					(a)	(a)					(a)	(a)	4, 159	2, 080
Illinois	481, 328	$754, 190	798, 683	720, 178	3, 548, 297	1, 933, 060	219, 523	451, 828	22, 736	$23, 750	148, 870	79, 143	1, 405, 267	704, 883
Indiana	80, 440	29, 955	564, 600	302, 839	1, 335, 199	654, 493	2, 065	1, 195	159	66	82, 098	46, 622	1, 422, 302	743, 423
Iowa			35, 654	40, 238	1, 004, 261	512, 413	17, 225	36, 288			61, 680	37, 627	670, 181	310, 750
Kansas					1, 183, 608	630, 893	(a)	(a)			7, 720	3, 910	465, 969	242, 067
Kentucky	(a)	(a)	43, 653	51, 021	664, 045	479, 204	(a)	(a)	(a)	(a)	14, 975	11, 835	47, 229	41, 881
Louisiana					474, 077	247, 934					(a)	(a)	236, 092	94, 880
Maine					54, 838	30, 000	(a)	(a)			756	264	(a)	(a)
Maryland	(a)	(a)	(a)	(a)	323, 770	313, 008	(a)	(a)			73, 937	101, 317	772, 915	546, 538
Massachusetts	1, 800	10, 800	23, 040	19, 495	924, 681	759, 791	1, 000	6, 000	14, 217	17, 098	77, 999	55, 900	36, 074	24, 839
Michigan	(a)	(a)	342, 936	84, 965	1, 748, 825	1, 143, 971	198, 691	39, 738	(a)	(a)	1, 915	790	1, 069, 859	530, 514
Minnesota			24, 420	24, 880	787, 032	449, 148	5, 687	13, 611	1, 368	1, 563	23, 014	11, 666	413, 062	217, 772
Mississippi					117, 701	53, 878	(a)	(a)			(a)	(a)	67, 485	31, 170
Missouri	145, 769	203, 931	117, 541	107, 726	795, 598	395, 767	(a)	(a)	(a)	(a)	14, 350	8, 676	773, 237	400, 361
Montana			35	88	11, 284	13, 919							14, 929	18, 658
Nebraska			(a)	(a)	825, 803	266, 303					119, 196	30, 135	75, 686	57, 422
Nevada											18, 531	1, 668		
New Hampshire					102, 062	90, 541							49, 000	35, 000
New Jersey	186, 898	306, 956	670, 225	833, 004	2, 755, 848	1, 277, 983	76, 499	205, 689	63, 719	89, 925	60, 899	31, 377	672, 338	339, 398
New Mexico			(a)	(a)	27, 077	22, 877	728	574			19, 207	8, 548	24, 557	14, 421
New York	(a)	(a)	731, 896	1, 212, 798	5, 491, 031	2, 661, 227	(a)	(a)	15, 005	10, 817	111, 037	57, 021	850, 798	640, 992
North Carolina			5, 400	2, 700	204, 051	81, 048					18, 137	8, 816	501, 844	144, 397
North Dakota					(a)	(a)								
Ohio	46, 189	101, 362	1, 053, 856	1, 688, 452	3, 114, 310	2, 281, 151	(a)	(a)	72, 698	150, 096	125, 072	88, 083	1, 389, 768	911, 588
Oklahoma	32, 619	55, 055			480, 043	338, 710					6, 655	4, 313	217, 889	127, 140
Oregon					415, 772	375, 316					14, 713	5, 964	100, 197	89, 431
Pennsylvania	351, 420	724, 700	781, 389	1, 271, 174	3, 033, 252	2, 900, 175	715, 257	1, 247, 416	81, 156	114, 376	352, 895	515, 465	1, 088, 248	993, 937
Rhode Island			(a)	(a)	5, 432	5, 705							(a)	(a)
South Carolina					117, 156	46, 785	(a)	(a)			(a)	(a)	61, 211	23, 893

South Dakota					67, 027	41, 404					1, 600	640	53, 003	26, 582
Tennessee			16, 371	13, 688	780, 257	575, 031	19, 420	15, 000	9, 263	3, 436	35, 472	23, 121	33, 208	27, 450
Texas	7, 488	13, 260	1, 855	2, 978	904, 089	422, 422					51, 137	19, 786	143, 161	99, 511
Utah					112, 986	50, 068					18, 114	8, 200	20, 250	7, 500
Vermont			1, 759	1, 165	3, 023	643	6, 800	1, 900					3, 184	612
Virginia	44, 734	97, 216	23, 931	25, 419	316, 442	176, 474	(a)	(a)	(a)	(a)	124, 960	67, 060	543, 438	221, 292
Washington			2, 656	1, 670	619, 173	310, 438	450	600			14, 140	6, 160	191, 107	85, 008
West Virginia	516, 638	1, 188, 093	24, 426	50, 774	587, 610	636, 414	8, 782	16, 324	1, 389	3, 072	153, 539	183, 925	222, 835	223, 124
Wisconsin			140, 995	124, 980	1, 499, 700	690, 263	(a)	(a)	2, 665	2, 665	66, 632	27, 393	789, 428	385, 829
Wyoming					122, 325	62, 450					21, 026	6, 766	21, 158	14, 516
Undistributed	139, 635	266, 260	21, 447	33, 497	152, 512	115, 096	181, 291	320, 422	23, 419	28, 615	56, 722	14, 012	128, 606	87, 399
	2, 034, 958	3, 751, 778	5, 559, 644	6, 730, 417	39, 234, 762	23, 751, 244	1, 456, 039	2, 361, 695	307, 794	445, 479	2, 033, 494	1, 535, 638	15, 632, 419	9, 187, 468
Average value		1. 84		1. 21		0. 61		1. 62		1. 45		0. 76		0. 59

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[a] Included under "Undistributed."

Sand and gravel sold or used by the producers in the United States in 1923, by States and uses—Continued

State	Filter sand		Other sands		Building gravel		Paving gravel		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(a)	(a)			268, 283	$245, 582	341, 227	$145, 660	476, 555	$59, 639	1, 829, 559	$760, 236
Arizona					(a)	(a)	(a)	(a)			(a)	(a)
Arkansas			(a)	(a)	11, 105	9, 571	485, 386	283, 028	729, 781	266, 739	1, 572, 240	826, 304
California	2, 990	$8, 724	102, 897	$27, 407	1, 305, 363	1, 174, 770	1, 335, 827	1, 122, 975	897, 915	271, 279	7, 205, 516	5, 033, 457
Colorado			(a)	(a)	10, 713	11, 050	28, 856	31, 996	(a)	(a)	185, 994	126, 967
Connecticut			366	558	111, 068	99, 685	(a)	(a)	281, 322	21, 098	691, 039	303, 443
Delaware			4, 197	2, 254							53, 022	34, 113
District of Columbia					(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Florida					4, 400	3, 520	114, 680	69, 860			513, 245	290, 082
Georgia			(a)	(a)	(a)	(a)	48, 500	40, 150	(a)	(a)	595, 117	300, 621
Hawaii									(a)	(a)	(a)	(a)
Idaho					16, 560	7, 500	33, 181	14, 691	41, 522	17, 552	97, 044	43, 039
Illinois	1, 816	7, 356	186, 347	150, 306	2, 259, 994	1, 241, 865	1, 917, 260	1, 059, 312	960, 924	334, 867	11, 951, 045	7, 460, 738
Indiana	50	25	46, 842	23, 302	1, 107, 450	748, 625	2, 686, 891	1, 554, 537	3, 590, 182	885, 424	10, 918, 278	4, 990, 506
Iowa	11, 968	7, 505	31, 364	20, 455	343, 078	331, 045	837, 558	634, 020	584, 191	251, 540	3, 597, 160	2, 181, 881
Kansas	(a)	(a)	25, 090	4, 867	59, 705	21, 272	117, 320	123, 927	85, 016	10, 631	1, 950, 411	1, 039, 064
Kentucky					563, 685	375, 573	272, 458	192, 252	484, 160	111, 594	2, 101, 840	1, 279, 441
Louisiana			(a)	(a)	366, 181	285, 249	1, 277, 915	979, 493	533, 723	316, 105	2, 905, 609	1, 926, 917
Maine			15, 155	3, 545	39, 229	46, 077	30, 880	26, 509	387, 934	57, 124	531, 937	169, 905
Maryland			(a)	(a)	396, 735	537, 719	437, 882	583, 482	(a)	(a)	2, 044, 490	2, 155, 353
Massachusetts	5, 210	10, 775	3, 788	12, 301	659, 467	829, 015	60, 939	72, 824	5, 500	2, 278	1, 813, 715	1, 821, 116
Michigan			34, 426	17, 787	2, 259, 966	1, 204, 017	2, 827, 204	1, 710, 090	1, 078, 343	257, 564	9, 601, 562	5, 096, 071
Minnesota	8, 728	23, 948	46, 584	18, 276	544, 672	642, 821	569, 026	448, 923	1, 402, 879	331, 498	3, 826, 472	2, 184, 106
Mississippi					175, 602	111, 381	1, 273, 736	627, 972	1, 132, 581	402, 282	2, 772, 149	1, 229, 809
Missouri					418, 748	180, 794	719, 599	379, 980	626, 511	249, 254	3, 719, 243	2, 007, 529
Montana					16, 490	12, 694	35, 636	40, 685	286, 929	70, 013	365, 303	156, 057
Nebraska	(a)	(a)	7, 462	2, 371	310, 192	207, 256	493, 412	335, 327	77, 535	16, 210	1, 930, 104	921, 433
Nevada			4, 633	417					246, 160	54, 853	269, 324	56, 938
New Hampshire					89, 420	118, 516	245, 000	175, 000	19, 581	4, 797	505, 063	423, 854
New Jersey	33, 740	54, 635	74, 660	85, 370	1, 366, 212	1, 065, 264	140, 166	92, 254			6, 101, 204	4, 381, 855
New Mexico	140	200	2, 500	475	35, 431	31, 625	42, 773	32, 056	(a)	(a)	464, 410	239, 470
New York	25, 227	12, 651	47, 439	36, 903	2, 862, 087	2, 165, 923	435, 296	394, 270	141, 248	83, 902	10, 730, 225	7, 291, 076
North Carolina			13, 000	9, 122	301, 711	367, 586	913, 671	781, 359	95, 103	19, 511	2, 052, 917	1, 414, 539
North Dakota									(a)	(a)	(a)	(a)
Ohio	(a)	(a)	4, 005	7, 544	1, 340, 000	1, 000, 870	1, 317, 296	868, 394	1, 620, 590	575, 466	10, 126, 977	7, 863, 375
Oklahoma	140	100	16, 679	5, 348	228, 078	129, 062	336, 151	270, 703	85, 931	44, 030	1, 404, 185	974, 461
Oregon			62, 882	19, 350	549, 316	464, 414	387, 694	311, 502	171, 865	54, 506	1, 702, 439	1, 320, 483
Pennsylvania	2, 705	2, 003	32, 044	22, 397	1, 826, 040	1, 388, 599	831, 940	717, 246	124, 946	46, 531	9, 221, 292	9, 944, 019
Rhode Island					600	700	405	750	47, 250	3, 544	69, 714	36, 373
South Carolina	(a)	(a)	(a)	(a)	102, 956	141, 097	92, 230	37, 263	136, 112	63, 271	581, 048	336, 109

South Dakota	100	250	2, 100	1, 000	20, 596	20, 295	51, 881	43, 206	108, 461	23, 537	304, 768	156, 914
Tennessee			8, 742	6, 259	348, 149	269, 421	528, 596	290, 950	88, 859	28, 728	1, 868, 337	1, 253, 084
Texas	503	614	27, 304	12, 496	982, 172	778, 020	1, 117, 527	644, 282	1, 824, 365	577, 625	5, 059, 601	2, 570, 994
Utah			398	25	137, 683	55, 877	214, 091	27, 612	708, 555	141, 525	1, 212, 077	290, 807
Vermont			([a])	([a])	5, 750	1, 473	2, 025	300	([a])	([a])	55, 551	18, 793
Virginia			([a])	([a])	494, 647	508, 390	500, 021	498, 460	90, 338	44, 406	2, 193, 861	1, 665, 439
Washington					787, 043	377, 615	735, 715	311, 185	1, 438, 825	270, 330	3, 789, 109	1, 363, 006
West Virginia			6, 250	7, 093	476, 539	511, 830	415, 592	370, 399	24, 000	9, 600	2, 437, 600	3, 200, 648
Wisconsin	([a])	([a])	43, 100	14, 650	682, 919	378, 241	1, 559, 302	1, 094, 062	223, 367	37, 916	5, 021, 608	2, 793, 999
Wyoming					101, 304	77, 089	205, 057	93, 105	906, 401	149, 985	1, 377, 271	403, 911
Undistributed	23, 203	10, 885	139, 387	58, 297	158, 124	188, 725	156, 310	184, 728	481, 847	178, 843	611, 478	565, 319
	116, 520	139, 671	989, 641	570, 175	24, 145, 463	18, 367, 713	26, 174, 112	17, 716, 779	22, 247, 307	6, 345, 597	139, 932, 153	90, 903, 654
Average value		1. 20		0. 58		0. 76		0. 68		0. 29		0. 65

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[a] Included under "Undistributed."

PRICES

The only figures relating to prices of sand and gravel compiled by the Geological Survey are those shown in the following table, which represent the total average values of the different grades of sand and gravel. They serve, however, as an index of the price changes in recent years, which have had a general upward trend from 1917 through 1920, followed by a downward trend to 1923, when some of the grades again showed an upward trend. The total average value in 1923 was 3 cents less per ton than in 1922, principally because an extended canvass of railroad companies was made to ascertain the quantity of noncommercial ballast used by them and this material was included in the total at a low unit value.

Average value per short ton of sand and gravel sold or used by the producers in the United States, 1917–1923

[Based on amounts received for sales f. o. b. pits or nearest shipping points]

Kind	1917	1918	1919	1920	1921	1922	1923
Glass sand	$1.38	$1.94	$1.97	$2.19	$1.81	$1.62	$1.84
Molding sand	.92	1.04	1.10	1.46	1.29	1.17	1.21
Building sand	.39	.50	.56	.68	.65	.60	.61
Grinding and polishing sand	1.04	1.60	1.34	1.80	1.61	1.46	1.62
Fire or furnace sand	1.15	1.48	1.23	1.81	1.56	1.42	1.45
Engine sand	.59	.76	.77	.82	.86	.76	.76
Paving sand	.41	.54	.66	.68	.63	.61	.59
Filter sand	.76	1.47	1.48	1.27	1.11	1.99	1.20
Railroad ballast	.17	.22	.30	.32	.33	.36	.29
Gravel (exclusive of railroad ballast)	.46	.57	.66	.81	.75	.72	.72
All sand and gravel	.46	.61	.65	.80	.71	.68	.65

IMPORTS AND EXPORTS [1]

The quantity of sand and gravel imported in 1923 was about 6 per cent more than in 1922. Most of it was building sand shipped across Lake Erie from Ontario and from Quebec. Much of this material comes into the country as ship ballast.

Sand and gravel imported for consumption in the United States in 1922 and 1923

	1922		1923	
	Short tons	Value	Short tons	Value
Glass sand	[a] 1,290	[a] $1,112	2,309	$3,008
Other sand	[a] 65,378	[a] 30,338	276,493	157,125
Gravel	[a] 65,848	[a] 27,434	198,960	99,687
Unclassified	[b] 319,427	[b] 179,502	----------	----------
	451,943	238,386	477,762	259,820

[a] Sept. 22–Dec. 31; not separately shown prior to new tariff.
[b] Jan. 1–Sept. 21.

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[1] Statistics of imports and exports compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Sand and gravel imported into the United States, 1922 and 1923, by countries

[General imports]

Country	1922 (Sept. 22 to Dec. 31) [a]		1923	
	Short tons	Value	Short tons	Value
North America:				
Canada	122,064	$51,687	399,252	$174,187
Mexico	485	433	206	80
Salvador	([b])	10		
South America:				
Brazil and Colombia			326	8,450
Europe:				
Austria			256	1,109
Belgium	6,712	3,714	73,757	60,238
Czechoslovakia			123	44
England			1,256	4,897
France	1,752	1,306	717	4,108
Germany			1,746	5,903
Netherlands	1,160	1,042	112	600
Asia:				
China			1	10
Japan	343	692	10	191
Palestine and Syria			([b])	3
	132,516	58,884	477,762	259,820

[a] Not separately shown prior to new tariff.
[b] Quantity not shown.

Exports of sand and gravel from the United States in 1923 amounted to 551,233 short tons, valued at $598,633, compared with 356,520 tons, valued at $400,199, in 1922. Of these totals 517,076 tons, valued at $554,894, was exported to Canada in 1923 and 342,732 tons, valued at $379,692, in 1922; and 30,382 tons, valued at $22,953, was exported to Mexico in 1923, and 11,450 tons, valued at $11,891, in 1922. The remainder of the sand and gravel exported in 1923 amounted to less than 1 per cent of the total and was shipped in small lots to 19 other countries.

GLASS SAND

One of the most valuable grades of sand sold is that which enters into the manufacture of glass. The purity of sand required for high-grade glass gives this sand a higher selling price than sand sold for other uses, although some sand sold for low-grade glassware does not bring so high a price as the washed, dried, and graded sand for molding, construction, and other special uses. West Virginia, Illinois, Pennsylvania, New Jersey, and Missouri (in order of quantity for 1923) produce most of the sand used for the manufacture of glass in this country. Descriptions of deposits of glass sand in the United States have been given in previous volumes of Mineral Resources. The location of deposits that were in operation in 1923 and the names of the operators as reported to the Geological Survey are given below.

- Arkansas:
  - Izard County:
    - Guion: Silica Products Co. (Inc.).
- California:
  - Monterey County:
    - Pacific Grove: Del Monte Properties Co.
- Georgia:
  - Wheeler County:
    - Lumber City: Hinson Sand Mines.
- Illinois:
  - Kendall County:
    - Millington: Ballou White Sand Co.
  - La Salle County:
    - Ottawa:
      - Crescent Silica Co. (address, Chicago).
      - Ottawa Silica Co.
      - South Ottawa Silica Works.
      - Standard Silica Co. (address, Chicago).
      - United States Silica Co. (address, Chicago).
    - Utica: E. J. Reynolds Sand Co.
    - Wedron: Wedron Silica Co. (address, Chicago).
  - Ogle County:
    - Oregon: National Silica Co.
- Indiana:
  - La Porte County:
    - Michigan City:
      - Hoosier Slide Sand Co.
      - Adolf Van Spange.
- Kentucky:
  - Carter County:
    - Lawton: Interstate Window Glass Co.
- Maryland:
  - Washington County:
    - Hancock: Maryland Glass Sand Co. (Inc.) (address, Hagerstown).
- Massachusetts:
  - Berkshire County:
    - Cheshire: Berkshire Glass Sand Co. (address, Farnams).
- Michigan:
  - Wayne County:
    - Rockwood: Michigan Silica Co.
- Missouri:
  - Franklin County:
    - Gray Summit: Tavern Rock Sand Co. (address, St. Louis).
  - Jefferson County:
    - Crystal City: Pittsburgh Plate Glass Co. (address, Pittsburgh, Pa.).
  - St. Charles County:
    - Klondike: Tavern Rock Sand Co. (address, St. Louis).
  - St. Louis County:
    - Pacific:
      - Walter W. Goran.
      - Tavern Rock Sand Co. (address, St. Louis).
- New Jersey:
  - Camden County:
    - Penbryn: Reading Sand Co. (address, Bridgeton).
    - Williamstown Junction: Bridgeton Sand Co. (address, Bridgeton).
  - Cumberland County:
    - Cedarville and South Vineland: Crystal Sand Co. (address, Bridgeton).
    - South Vineland: Whitall Tatum Co. (address, Millville).
  - Middlesex County:
    - South River: Marcus S. Wright.
- New York:
  - Oswego County:
    - Cleveland: Oneida Lake Sand Co.

- Ohio:
  - Fairfield County:
    - Rushville: Ohio Flint & Glass Sand Co. (address, Zanesville).
  - Knox County:
    - Howard: Millwood White Sand Co.
  - Licking County:
    - Toboso: Edward H. Everett Co. (address, Newark).
  - Mahoning County:
    - Austintown: National Sand & Stone Co. (address, Niles).
  - Perry County:
    - Chalfants: Central Silica Co. (address, Zanesville).
- Oklahoma:
  - Pontotoc County:
    - Roff: Mid-Continent Glass Sand Co.
- Pennsylvania:
  - Elk County:
    - Daguscahonda: Silicon Products Co. (address, Ridgway).
  - Fayette County:
    - Masontown: Sterling Sand Co.
  - Forest County:
    - Parrish: Standard Silicon Co. (address, Ridgway).
  - Huntingdon County:
    - Mapleton Depot:
      - Juniata White Sand Co. (address, Baltimore, Md.).
      - Pennsylvania Glass Sand Co. (address, Lewistown).
      - Pittsburgh White Sand Co. (address, Pittsburgh).
  - Mifflin County:
    - Newton Hamilton: Crystal Sand Co. (address, Latrobe).
    - Vineyard: Pennsylvania Glass Sand Co. (address, Lewistown).
  - Venango County:
    - Kennerdell: Pittsburgh Plate Glass Co. (address, Pittsburgh).
- Texas:
  - Atascosa County:
    - Haiduk: Julius E. Espey (address, San Antonio).
  - Coleman County:
    - Santa Anna: Parker Silica Sand Co.
- Virginia:
  - Scott County:
    - Cassard: Pennsylvania Glass Sand Co. (address, Lewistown, Pa.).
    - Mendota: Clinch Mountain Silica Sand Corporation.
- West Virginia:
  - Fayette County:
    - Thayer: Sun Sand Co. (address, Charleston).
  - Monongalia County:
    - Sturgisson:
      - Decker's Creek Stone & Sand Co. (address, Morgantown).
      - Silica Glass Sand Co. (address, Morgantown).
  - Morgan County:
    - Berkeley Springs:
      - Berkeley Glass Sand Co.
      - E. F. Millard Sand Works.
      - Speer White Sand Co.
      - West Virginia & Pittsburgh Sand Co.
    - Brosius: Pennsylvania Glass Sand Co. (address, Lewistown, Pa.).
    - Great Cacapon: Hazel Atlas Glass Co. (address, Wheeling)

TALC AND SOAPSTONE

By B. H. Stoddard [1]

PRODUCTION

The talc industry in 1923 practically kept the high position it won in 1922, after a period of depression in 1921 and the early part of 1922, as shown by a comparison of the figures for 1923 with those of earlier years. (See fig. 10.) In spite of a generally poor market in the East, the center of the industry—the demand at times not being equal to the supply, with lowered prices, especially for the roofing grades, and keen competition—the total sales were only 1 per cent less in quantity than in 1922, and the total value was 5 per cent higher.

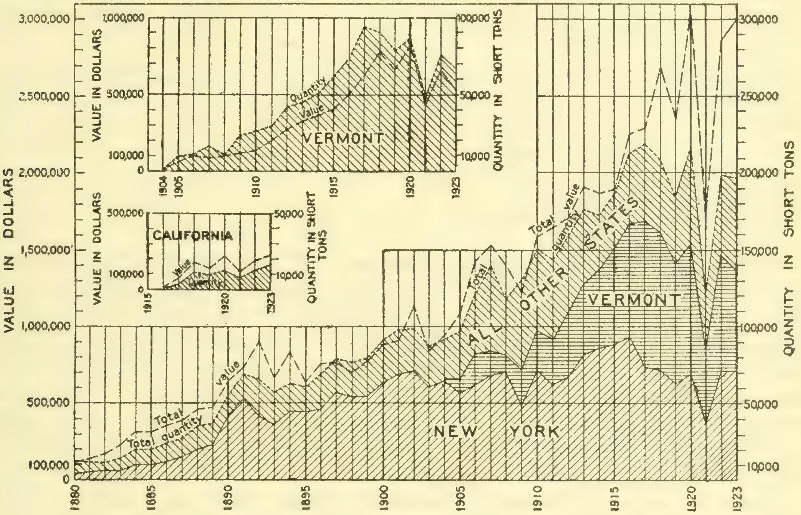

FIGURE 10.—Talc and soapstone produced in the United States, 1880–1923

Talc and soapstone sold in the United States, 1919–1923

Year	Crude		Sawed and manufactured				Ground		Total	
			Talc		Soapstone					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1919	15,625	$73,437	921	$147,339	16,504	$530,163	151,793	$1,601,736	184,843	$2,352,675
1920	11,008	43,820	1,415	139,335	19,707	709,400	178,505	2,142,894	210,635	3,035,449
1921	2,150	12,911	(a)	(a)	[b]17,423	[b]627,826	102,413	1,115,205	121,986	1,755,942
1922	4,981	22,582	654	86,333	22,700	712,144	170,349	2,038,838	198,684	2,859,897
1923	5,706	50,125	682	114,772	22,857	932,098	167,447	1,915,258	196,692	3,012,253

[a] Included under "Soapstone."
[b] Includes some sawed and manufactured talc.

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[1] The figures showing imports and exports have been compiled by J. A. Dorsey from the records of the Bureau of Foreign and Domestic Commerce, and those showing foreign production by Miss W. I. Whiteside.

The sales of the several grades of talc and soapstone are shown in the above table. Practically all talc sold in the crude state by producers is eventually ground, but as figures are collected only from producers the value of this material after grinding is unknown.

PRODUCTION BY STATES

Talc and soapstone sold in the United States, 1921–1923, by States

State	1921		1922		1923				
	Short tons	Value	Short tons	Value	Short tons	Value	Per cent of total quantity	Percentage of increase or decrease	
								Quantity	Value
New York	37,489	$464,645	71,470	$1,116,914	71,304	$1,079,322	36	−0.2	−3
Vermont	48,648	438,534	75,485	654,715	67,100	533,510	34	−11	−19
Virginia	17,721	601,878	25,351	736,132	26,095	960,628	14	+3	+30
California	8,233	128,188	12,638	187,011	16,144	224,838	8	+28	+20
Pennsylvania and New Jersey	7,205	76,912	8,373	87,367	8,182	82,597	4	−2	−5
North Carolina	731	17,048	2,194	23,049	6,491	89,290	3	+196	+287
Maryland	(a)	(a)	1,667	14,667	580	25,500	1	−65	+74
Other States [b]	1,959	28,737	1,506	40,042	796	16,568		−47	−59
	[a]121,986	[a]1,755,942	198,684	2,859,897	196,692	3,012,253	100	−1	+5

[a] Included under "Other States."
[b] 1921: Georgia and Massachusetts; 1922 and 1923: Georgia.

California.—Most of the talc mined in California is pure white, and its color, together with its purity and good slip, renders it suitable for the manufacture of talcum powder. In 1923 there were 7 producers, compared with 6 in 1922. The American Talc Co. ceased operations and leased its property, near Acme, to the Master Products Co., 5756 Alba Street, Los Angeles, which produced crude talc. Walter S. McLean shipped crude talc from Butte and Eldorado counties. Mining Topics of November 6, 1923, reported that Mr. McLean is mining and shipping soapstone in carload lots from the big deposit on the Western Pacific Railroad not far from Oroville, Butte County, for use at the chemical plants around San Francisco Bay. The Pacific Coast Talc Co., 2149 Bay Street, Los Angeles, increased its output of high-grade talc mined near Silver Lake; the Russi Soapstone Co., Folsom, formerly A. W. Prouty, shipped crude talc from Eldorado County near Shingle; the Sierra Talc Co., 401 Equitable Bank Building, Los Angeles, shipped high-grade talc from its property in Inyo County near Keeler; and the Tramway Talc Co., Keeler, shipped crude talc from Inyo County near Keeler. G. W. Morton also shipped a small amount of crude talc from Acme. The Western Talc & Magnesite Co., Los Angeles, bought property near Acme and is reported to be extensively developing the mines preparatory to shipping in 1924. The talc is said to be of high grade. One of the largest producers of talc in California reports business as steadily increasing. The average value of crude talc shipped in 1923 was $5.77 a ton, and in 1922 $5.76; the average value of ground talc was $17.43 a ton in 1923 and $18.02 in 1922. These were the only grades mined in California in 1922 and 1923.

Georgia.—The Georgia Talc Co., Asheville, N. C., was the only producer of talc in Georgia in 1923. Most of the product was sold in the ground form, but some was used in the manufacture of crayons.

Maryland.—The Harford Talc Co., which mines a refractory talc, was the only shipper in Maryland in 1923.

New Jersey and Pennsylvania.—Operations in the Easton-Phillipsburg district of New Jersey and Pennsylvania continued as usual, the Rock Products Co., 403 Trust Building, J. O. Wagener & Co., 520 McCartney Street, and C. K. Williams & Co., 640 North Thirteenth Street, all of Easton, Pa., being the producers. The material shipped was all in the ground form and ranged in price from about $8.50 to $13 a short ton.

New York.—Three firms produced talc in New York in 1923—the Carbola Chemical Co., 299 Ely Avenue, Long Island City; the International Pulp Co., 41 Park Row, New York City; and the W. H. Loomis Talc Corporation, 173 East Main Street, Gouverneur. Ground talc was the only grade shipped, and the average value per short ton was $15.14.

North Carolina.—The Georgia Talc Co., Asheville, N. C., continued the manufacture of crayons at its property near Marshall, Madison County. The output of the Standard Mineral Co., operating in the pyrophyllite region in Moore County, near Hemp, greatly exceeded that of 1922. This company has moved its office from New York City to Hemp. The National Soapstone Co. (Inc.), Baldwin, reported in March, 1924, that it had opened its quarry 5½ miles south of Jefferson and expected to make shipments soon. The offices of the company have been moved from Roanoke, Va., to the plant near Baldwin. The Talc Products Co.'s mill at Glendon has been temporarily closed pending new construction.

Vermont.—Activities in Vermont in 1923 were practically the same as in 1922. No new operators were reported, but the Eastern Talc Co. and the Magnesia Talc Co. were absorbed by the Eastern Magnesia Talc Co. (Inc.), Burlington. On account of the low prices prevailing during the year, especially for roofing grades, the industry was dull and production exceeded the demand. However, one producer reported (January, 1924) that the new year opened with a "marked increase in demand" for ground talc. The five producers in this State sold their product ground, except the Magnesia Talc Co., which used some of its talc for the manufacture of crayons and whose production of crayons greatly exceeded that of 1922.

Virginia.—The talc and soapstone output in Virginia in 1923 was the largest on record, and the quantity was 3 per cent higher than it was in 1922, the previous record year. The product in this State is nearly all soapstone, manufactured by the Virginia Alberene Corporation, 153 West Twenty-third Street, New York City, at its property near Schuyler. The Bull Run Talc & Soapstone Co. (Inc.) sold ground talc from its property near Clifton. The Blue Ridge Talc Co., near Henry, sold ground talc and a small amount of crude talc. A new company, the Charlottesville Soapstone Corporation (Inc.), Charlottesville, whose property is 4 miles west of Esmont, Albemarle County, was reported to be opening up a quarry preparatory to manufacturing soapstone. Oliver Bros. (Inc.), who formerly operated the Phoenix Soapstone Co.'s quarries, ceased operations in

1920. In August, 1922, the Phoenix Stone Co., 111 Broadway New York City, leased the property at Arrington, but there has been no output from this property since 1920.

WORLD'S PRODUCTION

World's production of talc and soapstone, 1919–1923, by countries, in metric tons

Country	1919	1920	1921	1922	1923
Argentina [a]	([b])	20	([b])	([b])	([b])
Australia:					
New South Wales [c]	364	214	61	203	207
South Australia [d]	268	201	262	272	425
Austria [e]	[e] 2,004	6,894	8,031	13,511	7,489
Canada [f]	16,912	19,659	9,184	11,970	9,141
France [g]	35,600	52,420	34,742	48,170	([b])
Germany (Bavaria) [h]	5,371	20,943	6,619	4,513	([b])
India [i]	2,169	3,740	2,103	921	([b])
Italy [j]	17,550	21,475	21,031	26,485	31,150
Norway [k]	2,988	----------	2,810	7,821	([b])
Spain [l]	3,024	2,146	1,115	3,078	1,983
Sweden [m]	([b])	([b])	1,797	2,063	([b])
Union of South Africa: Transvaal [n]	687	619	375	309	322
United Kingdom [o]	699	367	----------	51	([b])
United States	167,686	191,084	110,663	180,242	178,435

[a] Data furnished by Dirección general de minas, geología é hidrología, Argentina.
[b] Data not available.
[c] New South Wales Dept. Mines Ann. Repts.
[d] South Australia Dept. Mines Rev. Mining Operations.
[e] Exports. Aussenhandel Oesterreichs. Figures for 1919 represent second half of year only.
[f] Canada Dept. Mines, Mines Branch, Ann. Repts. Dominion Bur. Statistics Ann. Rept. 1921, Prelim. Repts., 1922–1923.
[g] 1919–1921: Statistique de l'industrie minérale en France. 1922: Information furnished by Ministry of Public Works, Paris.
[h] 1919–20: Consular rept., Mar. 18, 1922. 1921–22: Glückauf.
[i] India Geol. Survey Rec.
[j] Rivista del servizio minerario. Information furnished by the Ispettorato generale delle miniere, Rome.
[k] Norges Officielle Statistikk, Norges Bergverksdrift.
[l] Estadística minera de España.
[m] Bergshantering. Figures for 1921–22 do not include small amounts for which only value is given.
[n] Ann. Repts. Sec. Mines, Union of South Africa, Dept. Mines. Dept. Mines and Ind., Monthly Reports
[o] 1919–20: Mines and Quarries. 1921–22: Ann. Rept. Sec. Mines and H. M. Chief Inspector Mines.

IMPORTS AND EXPORTS

Talc imported for consumption in the United States, 1919–1923

Year	Crude and unground steatite and French chalk [a]			Manufactures (except toilet preparations) wholly or partly finished [b]			Total	
	Short tons	Value		Short tons	Value		Short tons	Value
		Total	Average		Total	Average		
1919	1,641	$10,105	$6.16	12,961	$248,899	$19.20	14,602	$259,004
1920	941	7,206	7.57	21,739	443,514	20.40	22,680	450,720
1921	153	2,279	14.90	11,468	239,469	20.88	11,621	241,748
1922	248	9,850	40.00	[b] 18,196	[b] 367,528	20.20	18,444	377,378
1923	560	20,653	36.88	19,405	402,238	20.73	19,965	422,891

[a] To Sept. 21, 1922, duty free; after Sept. 21 duty was ¼ cent a pound.
[b] Prior to Sept. 22, 1922, classified as "Talc, steatite, and French chalk—cut, ground, or washed," with 15 per cent duty. From Sept. 22 to Dec. 31, 1922, under the new tariff, the totals include items classified as follows: "Ground, washed, powdered, or pulverized (except toilet preparations)," 3,964 tons, $86,707 (duty of 25 per cent ad valorem); "cut or sawed, or in blanks, crayons, cubes, disks or other forms," 12 tons, $2,134 (duty of 1 cent a pound); "manufactures (except toilet preparations) wholly or partly finished, not decorated," 138 pounds, $109 (duty of 35 per cent ad valorem); "manufactures (except toilet preparations) wholly or partly finished, decorated," 1,411 pounds, $324 (duty of 45 per cent ad valorem).

General imports of talc, ground or unground, into the United States, 1919–1923, in short tons

Country	1919	1920	1921	1922			1923		
				Quantity	Value in country of origin		Quantity	Value in country of origin	
					Total	Average		Value	Average
Austria		22	361	297	$12,916	$43.49	611	$19,914	$32.59
Belgium				20	128	6.40	822	5,428	6.60
Canada	11,852	15,123	6,993	9,928	149,747	15.08	7,111	99,902	14.05
China				1	441	441.00	2	2,376	1,188.00
Chosen							([a])	4	[b] 1.33
Denmark		11							
England		34	72	2	387	193.50	123	2,722	22.13
France	163	1,834	1,031	2,528	46,702	18.47	3,384	51,035	15.08
French Africa		22							
Germany		2	1	([c])	24		36	1,167	32.42
Greece							3	57	19.00
Hongkong				([c])	1		([d])	59	[b] .24
India (British)		1	1	15	700	46.67	55	3,446	62.65
Ireland			([c])						
Italy	958	4,619	2,969	5,470	160,211	29.29	7,457	227,858	30.56
Jamaica		33		30	274	9.13			
Japan							2	1,113	556.50
Kwangtung (leased territory)			([c])						
Norway				11	97	8.82	347	9,073	26.15
Other British West Indies		28							
Scotland							1	45	45.00
Sweden		([c])							
Switzerland			28	([c])	56		34	1,078	31.71
	12,973	21,729	11,456	18,302	371,684	20.31	19,988	425,277	21.28

[a] 3 pounds. [b] Per pound. [c] Less than 1 ton. [d] 241 pounds.

Exports of talc in bulk are not recorded. The exports of "talcum and other toilet powders" in 1922 amounted to 1,821 tons, valued at $1,397.542; in 1923, 1,907 tons, valued at $1,671,588.

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POTASH[1]

By George Rogers Mansfield and Leona Boardman

INTRODUCTION

The year 1923 was marked by unusually low prices for foreign potash. For example, 50 per cent muriate was offered for $29.82 a ton f. o. b. Atlantic ports, whereas in 1922 the price was $32 a ton and in 1913, the last normal year before the war, it was $33.21 a ton. In view of the differences in costs of equipment, supplies, and labor, and in general living conditions between 1923 and 1913, it will be seen that the situation of the American potash industry as regards foreign competition was particularly unfavorable. Nevertheless, it not only maintained the level of production it had reached in 1922 but made a notable advance. This was due largely to the increased output of the American Trona Corporation, which by careful technology and judicious management has been able steadily to reduce the costs, improve the quality, and increase the amount of its product.

The number of operating companies was eight in 1923, compared with nine in 1922, but the number of plants operated (12) remained the same.

Further interest was attracted to the Texas field by the discovery of oil in Reagan County and the consequent increased drilling activity there. Although no quantitative information regarding potash was obtained, the finding of potash at corresponding depths in a number of wells drilled near together served to direct attention to this district as a possible site of one or more commercial beds of potash. A more detailed statement regarding the Texas field is given on pages 178–185.

PRODUCTION AND SALES

The production and sales of potash in the United States in 1923 are summarized in the following table with as much detail as is possible without revealing individual reports that must be considered confidential.

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[1] Since 1910 a chapter on potash has appeared annually in Mineral Resources of the United States. Extensive bibliographies and lists of United States patents covering processes for the extraction of potash from silicate rocks have been included in most of these chapters. The chapter for 1910 contained a brief account of the German potash deposits, the chapter for 1915 gave simple tests for potash, those for 1916 and 1917 included descriptions of the sources of potash in this country and brief statements concerning efforts to produce potash from other sources, and the chapter for 1918 included descriptions of refined potassium salts.

Potash produced, sold, and in stock in the United States in 1923, by sources

	Organic		Mineral		Total
	Molasses distillery waste	Steffens water from beet-sugar refineries	Natural brines	Dust from cement mills and blast furnaces	
Production:					
Number of plants reporting	1	1	3	7	12
Crude potash short tons	6,700	75	32,254		39,029
Available content of K_2O—					
Short tons	2,211	22	17,982		20,215
Percentage of total	10.9	0.1	89.0		100
Sales:					
Number of plants reporting	1	1	3	6	11
Crude potash short tons	44	5	31,079	4,036	35,164
Available content of K_2O do	11	1	17,984	1,285	19,281
Value f. o. b. plant	$654	$225	$693,764	$90,028	$784,671
Stocks on hand Dec. 31, 1923:					
Number of plants reporting	1	1	5	7	14
Crude potash short tons	18,900	70	10,309	5,515	34,794
Available content of K_2O do	6,237	21	4,890	1,215	12,363

The production in 1923 shows an increase of 55 per cent in crude potash and of 73 per cent in the available potash content (K_2O). Practically all of this increased production came from mineral sources. The average percentage of available potash (K_2O) was 51.8, as compared with 46.5 per cent in 1922.

The sales of crude potash were 60 per cent greater and the available potash content of the material sold 70 per cent greater than in the previous year. The value of the potash sold in 1923 was 69 per cent more than in 1922, but the average value per unit (20 pounds of K_2O) remained the same—41 cents.

Potash produced and sold in the United States, 1916–1923

Year	Number of plants		Production		Sales [a]		
	Total	Exclusive of producers of wood-ash potash	Crude potash (short tons)	Available content of K_2O (short tons)	Crude potash (short tons)	Available content of K_2O (short tons)	Value f. o. b. plant
1916	70	25	35,739	9,720	35,739	9,720	$4,242,730
1917	95	46	126,961	32,573	126,961	32,573	13,980,577
1918	128	77	207,686	54,803	140,343	38,580	15,839,618
1919	102	67	116,634	32,474	166,063	45,728	11,271,269
1920	66	49	166,834	48,077	139,963	41,444	7,463,026
1921	20	19	25,485	10,171	10,337	4,408	447,859
1922	12	12	25,176	11,714	22,028	11,313	463,512
1923	12	12	39,029	20,215	35,164	19,281	784,671

[a] Production and sales were practically the same in 1916 and 1917, and no distinction was made between them.

A comparison of the figures for 1923 with those for previous years shows a production of K_2O almost double that for 1922 and close to two-fifths of that for 1918, when domestic production was at its height.

Potash produced in the United States in 1923, by States

State	Number of plants	Crude potash (short tons)	Available content of K_2O	
			Short tons	Percentage of total
California	3	31, 536	17, 924	88. 7
Maryland	1	6, 700	2, 211	10. 9
Indiana	1	75	22	. 1
Pennsylvania	6	718	58	. 3
Nevada	1			
	12	39, 029	20, 215	100. 0

In only two States was potash produced in 1923 in more than two plants. California was by far the largest producer. The figures for Pennsylvania and Nevada are combined in order to avoid revealing confidential information.

Domestic potash sold in the United States in 1922 and 1923

Material sold	Crude potash (short tons)	Available content of K_2O		
		Per cent	Short tons	Percentage of total
1922				
Chloride	17, 313	29–57	9, 526	84. 2
Sulphate	1, 683	8–33	521	4. 6
Mixed salts	3, 032	25–55	1, 266	11. 2
	22, 028	------------	11, 313	100. 0
1923				
Chloride	30, 079	44–59	17, 734	92. 0
Dust from cement mills and blast furnaces	4, 036	0. 75–33	1, 285	6. 6
Mixed salts	1, 000	25	250	1. 3
Sulphate [a]	44	25	11	. 1
Carbonate	5	30	1	
	35, 164	------------	19, 281	100. 0

[a] Exclusive of sulphate produced from dust from cement mills and blast furnaces.

The material sold in 1923 consisted chiefly of chloride. Very little sulphate was produced in addition to that obtained from the dust from cement mills and blast furnaces, which is recorded separately in the preceding table.

IMPORTS

The imports of potash materials for 1923 are shown in the following table. The materials are classified into salts used principally in the fertilizer industry and those used principally in the chemical industries. The former class, including kainite, manure salts, muriate, and sulphate, constituted 92.5 per cent of the total imports.

Potash materials imported for consumption in the United States, 1913, 1922, and 1923 [a]

Material	Approximate K_2O content (per cent)	1913				1922				1923			
		Short tons	Available content of K_2O		Value	Short tons	Available content of K_2O		Value	Short tons	Available content of K_2O		Value
			Short tons	Percentage of total			Short tons	Percentage of total			Short tons	Percentage of total	
Used principally in fertilizers:													
Kainite	12.4	521, 176	64, 626	23.7	$2, 201, 730	169, 287	20, 992	10. 4	$1, 087, 895	187, 833	23, 291	11. 1	$977, 807
Manure salts	20.0	250, 529	50, 106	18.4	2, 245, 509	218, 406	43, 681	21. 7	1, 948, 608	301, 721	60, 344	28. 8	2, 939, 793
Muriate	50.0	237, 630	118, 815	43.6	7, 075, 745	179, 484	89, 742	44. 6	5, 485, 287	151, 757	75, 879	36. 1	4, 116, 180
Sulphate	48.6	44, 349	21, 554	7.9	1, 677, 429	65, 534	31, 849	15. 8	2, 429, 407	71, 390	34, 696	16. 5	2, 599, 695
		1, 053, 684	255, 101	93.6	13, 200, 413	632, 711	186, 264	92. 5	10, 951, 197	712, 701	194, 210	92. 5	10, 633, 475
Used principally in chemical industries:													
Bicarbonate	46.0	223	103		20, 968	323	149	. 1	32, 865	161	74		19, 954
Bitartrate (argol)	20.0	14, 499	2, 900	1. 1	2, 779, 180	11, 483	2, 297	1. 1	1, 709, 184	9, 832	1, 966	. 9	1, 499, 389
Bitartrate (cream of tartar)	25.0	75	19		28, 314	1, 042	260	. 1	395, 746	640	160	. 1	194, 084
Bromide	39.6									26	10		5, 736
Carbonate, crude	61.0	4, 858	2, 963	1. 1	272, 973	2, 901	1, 770	. 9	287, 172	4, 906	2, 993	1. 4	518, 632
Carbonate, crude or black salts	50.0	344	172	. 1	17, 852	1, 839	920	. 5	68, 856				
Carbonate, refined	67.0	6, 145	4, 117	1. 5	393, 284	237	159	. 1	27, 909				
Caustic	80.0	4, 324	3, 459	1. 3	342, 056	6, 774	5, 419	2. 7	759, 673	5, 419	4, 335	2. 1	685, 309
Chlorate and perchlorate	38.0	596	226	. 1	64, 468	3, 855	1, 465	. 7	300, 576	6, 749	2, 565	1. 2	569, 399
Chromate and bichromate	40.0	9	4		1, 819	4	2		1, 676	3	1		1, 033
Cyanide	70.0	735	514	. 2	216, 844	1, 544	1, 081	. 5	253, 072	983	688	. 3	161, 825
Ferricyanide (red prussiate)	42.0	34	14		12, 035	38	16		40, 324	56	24		66, 909
Ferrocyanide (yellow prussiate)	44.0	1, 706	751	. 3	388, 379	385	169	. 1	184, 317	188	83	. 1	82, 263
Iodide	28.0					(b)	(b)		21	(b)	(b)		140
Nitrate (saltpeter), crude	40.0	4, 826	1, 930	. 7	261, 078	2, 730	1, 092	. 5	141, 521	3, 077	1, 231	. 6	137, 228
Nitrate (saltpeter), refined	46.0	203	93		22, 602	401	184	. 1	49, 233	2, 962	1, 363	. 7	634, 921
Permanganate	29.0	273	79		38, 188	391	113	. 1	89, 456	561	163	. 1	142, 887
Rochelle salt	22.0	54	12		13, 412	251	55		74, 290	164	36		40, 917
All other	50.0									97	48		10, 471
		38, 904	17, 356	6.4	4, 873, 452	34, 198	15, 151	7. 5	4, 415, 891	35, 824	15, 740	7. 5	4, 771, 097
Grand total		1, 092, 588	272, 457	100. 0	18, 073, 865	666, 909	201, 415	100. 0	15, 367, 088	748, 525	209, 950	100. 0	15, 404, 572

[a] The figures in this table were compiled by J. A. Dorsey from the records of the Bureau of Foreign and Domestic Commerce by recalculation from pounds to short tons and to actual potash (K_2O) and by giving the totals for calendar years instead of fiscal years. The tons are calculated to the nearest even unit, and the values are those given in the original records, so that the value given for a high-priced commodity received in small quantity may not be strictly applicable to the quantity given in tons. Furthermore, the values are those placed on the commodities by the shippers and represent the values at point of shipment and do not agree with the market quotations in this country.

[b] Quantity of iodide imported was as follows: 1922, 5 pounds; 1923, 24 pounds.

In 1913, the last normal year before the war, the United States imported 272,457 short tons of K_2O. In 1923 the total imports were 209,950 short tons, or about 77 per cent of that amount. This was an increase of 8,535 short tons, or 4 per cent, over the imports in 1922.

Potash (K_2O) imported for consumption in the United States, 1913–1923, in short tons

1913	272, 457	1919	39, 619
1914	207, 089	1920	224, 792
1915	48, 867	1921	78, 698
1916	7, 885	1922	201, 415
1917	8, 100	1923	209, 950
1918	7, 957		

The following table indicates the amount of potash imported in 1923 from each country. Germany and France supplied direct, respectively, 55 and 30 per cent of the total imports. About 13 per cent came from Belgium, though the potash imported from that country doubtless originated in Germany and France.

Potash imported into the United States in 1923, in short tons [a]

[The figures in parentheses in the column headings indicate percentage of K_2O]

Country	Muriate (50)	Sulphate (48.6)	Manure salts (20)	Kainite (12.4)	Bitartrate argols or wine lees (20)	Caustic (80)
Algeria and Tunis					542	
Argentina					1, 129	
Austria						
Belgium	27, 530	2, 054	33, 712	29, 648		21
Canada	1, 465	52			16	
Chile					45	
China						
Czechoslovakia						433
Denmark						
England					10	
Finland				2, 517		
France	49, 065	3, 754	78, 804	87, 198	3, 791	16
Germany	73, 481	65, 181	188, 920	64, 497	([b])	4, 895
Hongkong	2		([b])			([b])
India (British)						
Italy					1, 935	
Japan		([b])				
Mexico			7			
Netherlands	112	165	165		53	17
Norway						([b])
Peru		1				
Portugal					884	
Scotland	102		113			
Spain					1, 469	
Sweden						47
Switzerland						
Turkey in Asia						
Turkey in Europe						
Venezuela					28	
	151, 757	71, 207	301, 721	183, 860	9, 902	5, 429
Content of potash (K_2O)	75, 879	34, 607	60, 344	22, 799	1, 980	4, 343

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[a] The figures in this table were compiled by J. A. Dorsey from the records of the Bureau of Foreign and Domestic Commerce by recalculation to short tons and to the actual potash (K_2O) and by giving the totals by the calendar year instead of the fiscal year. The tons are calculated to the nearest even unit. The data represent general imports and include both imports for immediate consumption and those going to warehouses, which may or may not be entered for consumption during the year. They differ slightly from the figures in the preceding table of imports, which represents imports for consumption.

[b] Less than 1 ton.

Potash imported into the United States in 1923, in short tons—Continued

Country	Carbonate (61)	Cyanide (70)	Nitrate of, or saltpeter, crude (40)	Ferrocyanide (44)	All other (50)	Total	
						Short tons	Value
Algeria and Tunis						542	$90, 348
Argentina						1, 129	129, 575
Austria					3	3	4, 358
Belgium		1	20		573	93, 559	1, 434, 547
Canada		808			(b)	2, 341	166, 600
Chile			2, 293			2, 338	111, 044
China					(b)	(b)	36
Czechoslovakia	200			23	46	702	94, 923
Denmark				28		28	16, 192
England	248	1		43	123	425	75, 013
Finland					336	2, 853	52, 057
France	248	83		7	1, 215	224, 181	3, 225, 416
Germany	3, 959	109	714	66	7, 980	409, 802	9, 034, 147
Hongkong	(b)		(b)		11	13	1, 379
India (British)			28			28	2, 763
Italy					108	2, 043	389, 521
Japan						(b)	54
Mexico		224				231	27, 320
Netherlands	95			29	344	980	132, 895
Norway			22			22	2, 061
Peru						1	50
Portugal					16	900	116, 678
Scotland		6				221	8, 848
Spain					13	1, 482	196, 766
Sweden					152	199	31, 696
Switzerland					666	666	67, 921
Turkey in Asia	178					178	18, 377
Turkey in Europe	547					547	57, 837
Venezuela						28	4, 026
	5, 475	1, 232	3, 077	196	11, 586	745, 442	15, 492, 448
Content of potash (K_2O)	3, 340	862	1, 231	86	5, 793	211, 264	

(b) Less than 1 ton.

EXPORTS

Some potash materials in the form of refined potassium salts are exported from the United States. In 1923 the value of the salts thus exported was only 65 per cent of the corresponding value in 1922.

Potassium salts exported from the United States, 1922–1923 [a]

Salt	1922			1923		
	Gross weight (short tons)	K_2O (short tons)	Value	Gross weight (short tons)	K_2O (short tons)	Value
Potassium chlorate	281	107	$51, 066	100	38	$21, 995
Potassium bichromate	2, 215	886	433, 552	1, 631	652	295, 751
All other potassium salts	3, 742	1, 646	296, 378	2, 266	997	188, 091
	6, 238	2, 639	780, 996	3, 997	1, 687	505, 837

[a] Table prepared by J. A. Dorsey from records of the Bureau of Foreign and Domestic Commerce.

CONSUMPTION OF POTASH IN THE UNITED STATES

The consumption of potash in the United States in 1923, as measured by the quantity imported and the quantity sold here, was 783,689 short tons of crude material, containing 229,231 short tons of K_2O, valued at $16,189,243. Of this quantity 4 per cent of the crude material, containing 8 per cent of the K_2O and representing 5 per cent of the total value, was produced in this country. The great bulk of this supply was used in the manufacture of fertilizers.

NEEDS FOR POTASH IN THE UNITED STATES

There are two principal needs for potash. Agriculture consumes more than 90 per cent of the total, and the balance is used by a group of chemical industries, some of which are indispensable to the national welfare.

Potash in agriculture.—Potash is one of the three principal essential constituents of plant food, the other two being phosphorus and nitrogen. The small amount of insoluble potash minerals present in most soils breaks down slowly and furnishes a diminishing supply of soluble potash which replenishes the soil from year to year, but exhaustion must come unless artificial supplies are added. The principal crops for which potash has been specifically used are cotton, tobacco, potatoes, and truck-farm products. It is, however, essential to other crops as well, and sooner or later our large grain-growing districts will have to use potash fertilizers to replenish their soils, which are already becoming depleted.

For example, according to the Bureau of Soils a crop of wheat yielding 25 bushels of grain and 2,500 pounds of straw removes from the soil in an acre of ground 80 pounds of nitrogen, phosphorus, and potash combined, of which 21 pounds is potash. This means that each bushel of wheat represents a withdrawal from the soil of 0.8 pound of potash. At this rate a crop of 250,000,000 bushels of wheat, approximately a normal year's exports, would mean a withdrawal from the soil of 100,000 tons of potash, or nearly five times the present total American production in terms of K_2O. If the potash contained in the straw were kept on the farm and returned to the soil by burning or otherwise the exportation of the grain would still remove from our country about 25,000 tons of potash (K_2O), or one and one-fourth times the total American production in 1923.

Fertilizers may be regarded as labor-saving devices, in that they permit a larger yield per unit of ground cultivated and hence a greater return per man employed on the farm. Americans have become so used to labor-saving machinery that it is inconceivable that they should continue much longer to disregard so largely so primary an element of farm economy as the use of fertilizers. It is fair, therefore, to assume that the fertilizer industry is in its infancy and that it will develop rapidly as farmers realize more and more their dependence upon fertilizers.

Of phosphates, one of the three essential fertilizer elements named above, this country has practically inexhaustible supplies. Nitrogen, though largely imported from Chile at the present time, is available from by-product coke ovens and organic wastes in considerable quantity; from clovers, cowpeas, and similar plants, which store nitrogen in their roots; and from the air by various artificial processes, which are now receiving the Government's consideration. For potash, however, we are still dependent in very large measure upon the whim or good will of foreign nations unless we can develop cheap domestic sources or so protect our own industry that it may manufacture potash in competition with foreign producers.

Potash in the chemical industries.—The chemical industries, though consuming roughly only about 10 per cent of the total potash used, touch our lives directly or indirectly in many ways. Our better soaps, especially shaving and shampooing preparations, and liquid soaps commonly used in lavatories are potash soaps, though during the war the potash in liquid soap was replaced by soda. Potash applied in dilute solutions with soap is extensively used in laundries to cleanse fine fabrics.

The better grades of glass, particularly cut glass, optical glass, and incandescent-light bulbs, require the use of potash. During the war our dependence upon Germany for fine grades of optical glass such as is necessary in range finders, telescopes, and other instruments became apparent. Fortunately, American ingenuity overcame this difficulty, but potash was a necessary adjunct to the successful outcome. In years of normal output about 3,000 short tons of hydrated potassium carbonate, valued at $250,000, has been imported from Germany for the glass industry.

It is estimated that the American people annually consume about 250,000,000,000 matches. Most of these are of the nonpoisonous variety, which requires some oxidizing agent for their ignition. Chlorate of potash is a favorite substance used for this purpose, though other substances that do not contain potash could be used.

Certain types of explosives contain potassium nitrate (saltpeter) as an essential ingredient. For example, black powder is still used where slow action is desired and is one of the common forms of blasting powder. During the war powder of this type was necessary for filling fuses, for igniting charges for nitrocellulose powders, for bursting charges in slower-acting shrapnel, and for signal lights.

Saltpeter has also had an important use as a preservative in the meat-packing industry, the familiar reddish color of corned beef being produced by it.

Chrome or mineral tanning of leather, which involves the use of potassium bichromate, is extensively practiced. Potash and potassium salts are also ingredients of many substances used in dyeing.

Metallurgy, electroplating, and photography are among the other industries in which small amounts of potassium salts are more or less essential.

It is clear, therefore, that an adequate supply of cheap potash is a vital necessity to our country, not only from its importance in the production of foodstuffs but also from the variety of other ways in which it affects our daily living.

MARKET CONDITIONS

As potash is so largely used in the cotton and tobacco growing States the market for it is chiefly in the States east of Mississippi River and south of Ohio River and the Mason and Dixon line, but some potash is used in the Northeastern States for potatoes and truck-farm products. More than 95 per cent of the potash consumed in the United States in 1923 was imported, 93 per cent coming directly or indirectly from Germany and France and the remainder in small amounts from other countries. By means of low production costs, cheap ocean freight charges to American Atlantic ports, and effective selling organizations in this country, Germany and France are making active efforts to acquire the entire American potash trade. The market under present conditions is highly competitive, and only those domestic companies that can operate on a low cost basis may hope to share it. The progress made by American producers during the last year is therefore highly significant of the virility of the organizations that participated in it. The outlook for new projects, however, is not encouraging.

AMERICAN POTASH INDUSTRY

As shown in a preceding table, there were 12 plants that produced potash during 1923. Of these plants, 3 utilized salines, 1 obtained it from cement manufacture, 6 from blast-furnace dusts, 1 from molasses-distillery waste, and 1 from beet-sugar waste (Steffens water). With the exception of the American Trona Corporation's plant, at Searles Lake, Calif., these plants produced potash as a relatively insignificant by-product of other industries. At the Searles Lake plant potash was the main product, but by-product borax helped to bear the cost of operation.

American Trona Corporation.—The American Trona Corporation, which is a subsidiary of the Consolidated Goldfields of South Africa (Ltd.), London, practically dominates the present American potash industry. According to recently published figures,[2] this company alone produced in 1923 about 30,000 tons of potash salts, averaging 96.5 per cent potassium chloride on the dry basis, together with about 14,000 tons of pure borax. This year (1924) the plant is doing still better. The report for the week ended February 13 showed a production of 732 tons of potassium chloride and 312 tons of borax, besides other products. If this rate can be maintained, the total production for the current year should exceed 38,000 tons of potash salts and 16,000 tons of borax. The purity of the product obtained is remarkable, being considerably above that of the usual commercial grades of potassium chloride.

The successful operation of this plant marks an achievement in chemical engineering, for the brine to be treated is complex, and the process employed involves concentration by artificial evaporation and crystallization under delicate temperature controls with the use of expensive machinery. Fuel and labor have to be brought in from the outside. Notwithstanding these disadvantages the company has steadily reduced its costs of production and has been meeting competitive foreign prices in eastern markets at rates even lower than before the war.

Other activities at Searles Lake.—The West End Consolidated Mining Co. and the Solvay Process Co. have plants at Searles Lake that have for some time been inactive. A new venture has been undertaken there by the Burnham Chemical Co., which employs a solar evaporation process and claims that it can produce potash, borax, and other salts from Searles Lake brines at much less cost than its competitors. This company's plant was visited in May, 1924, by a Survey representative. Tanks, washers, evaporating pans, and other structures representing the outlay of thousands of dollars had been erected and the company was busily preparing for commercial production, which it hoped might be begun by midsummer, 1924. If this venture is successful it may materially swell American potash production. It should be noted, however, that the process has not yet been tried out in a commercial way, though it appears to have been successful in its experimental stages. Moreover, the markets for both potash and borax, which are to be the chief products, are highly competitive, and the markets for the other salts which the company proposes to manufacture are not particularly active and will in large measure have to be developed in the future. The project is therefore to be regarded as still speculative to a considerable degree. Its outcome will be watched with interest.

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[2] Am. Fertilizer, Apr. 5, 1924, p. 31.

By-product potash.—Although in a sense all the potash now produced in the United States is by-product potash, it is hardly fair to apply this term to the American Trona Corporation's product, for this company's plant was designed primarily for the production of potash and it is now functioning in accordance with its original plan, notwithstanding the fact that it also produces considerable borax. Exact amounts can not be specified without disclosing confidential information, but it may be said that by-product potash in 1923 furnished in round numbers about 26 per cent of the total production of crude potash but only 15 per cent of the K_2O. At the present rate of increased production at the American Trona plant and with the possible introduction of the Burnham Chemical Co. as a producer, it is clear that this ratio will decrease in the future unless a larger number of industrial plants adopt means of recovering potash from their wastes. As the average K_2O content of all the potash salts produced in the country was about 52 per cent, it will be seen that the by-product potash, which averages only 31 per cent, is, on the whole, low-grade material.

GOVERNMENTAL ACTIVITIES

Geological Survey.—The activities of the Geological Survey in 1923 relative to potash were confined chiefly to the Texas potash field, described on pages 178–185. Walter B. Lang, the Survey's representative, with field headquarters at Midland, Tex., visited all available wells, interviewed drillers, and procured samples of cuttings and brines, which were analyzed at the laboratories of the Survey in Washington.

In addition, J. T. Pardee examined a tract of land near Whitehall, Mont., for which application for patent under the potash leasing law had been made. This land proved to contain no soluble potash salts, but instead considerable areas in which potash-bearing feldspar was exposed. These areas are briefly described on page 178.

Publications on potash during the year included the annual chapter on potash in Mineral Resources for 1922 and Press Notice 16953, "More evidence of potash in western Texas."

Bureau of Mines.—The Bureau of Mines is charged with the administration of leases under the potash leasing law and has been actively occupied during the year in that work. The bureau has kept track of potash activities in general but has initiated no investigations relating to the subject.

The following statement, kindly supplied by Mr. C. C. Mather, of the bureau, shows that in the Western States considerable interest is being maintained in lands that are potentially potash bearing.

> The records of this office show that under the provisions of the potash act of October 2, 1917, 312 potash permits were issued up to and including June 30, 1924, covering an area of 728,456.48 acres. Up to the same date six potash leases were issued, covering an area of 9,943.76 acres.
>
> For the fiscal year 1924 37 potash permits were issued, covering 76,485.76 acres, and two potash leases, covering 2,600 acres.
>
> The following statement shows the States in which the permits and leases were issued:

State	Leases	Permits	State	Leases	Permits
Arizona		3	New Mexico		8
California	5	14	Oregon		1
Colorado		1	Utah		255
Montana		1	Wyoming	1	
Nebraska		1			
Nevada		28		6	312

Bureau of Soils.—The Bureau of Soils has recently issued publications summarizing its earlier work on blast-furnace dusts and on kelp. (See bibliography, p. 200.) The following statement, kindly furnished by Dr. J. W. Turrentine, scientist in charge of the bureau's potash investigations, expresses the bureau's view of the American potash industry.

> We have in sight, we feel, the early and successful solution of the essential and most pressing phases of our potash problem. From industrial wastes, in industries already operating on a successful basis, wherein through the installation of more economical methods and machinery by-products can be developed, we expect to recover a large portion of our present and future potash requirements. I refer particularly to the blast-furnace, the cement, the sugar, the distillery, and the borax industries. In the larger of these industries surveys have been completed, and the quantities of potash which can be yielded as a by-product have been determined. The feasibility of its recovery has been demonstrated; but there yet remains the perfection of methods, the improvement in processes which will make its recovery so attractive economically that these industries will be impelled to conserve it. We feel that these problems are near solution, that this solution is almost within our grasp, and that a short period of aggressive chemical and engineering research will enable us to remove the remaining difficulties and demonstrate the substantial profits which we feel confident can be realized from the recovery of this potash. Wartime momentum has been largely lost, but there yet remains in important quarters a great deal of interest in this problem which can be utilized collaboratively to further the enterprise if there be not too great a delay in taking advantage of it.
>
> What we have in mind with respect to the development of a by-product potash industry may be illustrated by an analogous conservation already realized which makes available for American agriculture great quantities of that other essential of present fertilizer practice, namely, ammonium sulphate. This chemical is a by-product of the coking industry, and its value has now become so well recognized and its production so well standardized that the coking of coal without by-products has almost disappeared and the production of by-product ammonia has advanced from nothing to a yearly output of almost 600,000 tons. What has happened in the coking industry it is our hope to see duplicated in the blast-furnace, the cement, the sugar, and the distillery industries. The important results already obtained in governmental and private researches convince us that this is an entirely reasonable expectation.
>
> Potash yielded from these industries would be distributed economically, as it would be produced for the most part near the points of consumption. Long freight hauls and the great expense thereby incurred would be avoided.
>
> In certain mineral deposits already surveyed are further quantities of potash, enormous in extent but awaiting before becoming available considerable more re-

search, to determine more profitable methods of recovery. The greensands of New Jersey, the potash shales of Georgia, the leucites of Wyoming, and the alunites of Utah contain in the aggregate inexhaustible quantities of potash, and methods of recovering it therefrom are now much nearer solution than is generally recognized. The problem is one of by-products—other values to be recovered with the potash to cheapen its cost of manufacture. Results now in hand warrant the expectation that all of these materials can with further research be made to yield their quota to the Nation's potash supplies.

Finally, the observations recorded in the Texas Panhandle showing unmistakable evidences of subterranean potash deposits convince us that in some one of these three fields of research, if not in all of them, adequate quantities of potash will be produced certainly to render the American farmer free from danger of unrestricted exploitation by foreign monopoly, if not to supply the Nation with its entire requirements in respect to that essential commodity.

POTASH FELDSPAR IN MONTANA

In July, 1923, J. T. Pardee, from whose account the following statement is taken, examined a tract of land in sec. 18, T. 1 N., R. 2 W., about 10 miles east of Whitehall, Mont., which had been included in an application for patent by Donald A. Morrison, of Whitehall. Limespur, a station on the Northern Pacific Railway on the north side of Jefferson River, is near the south quarter corner of sec. 18. The Chicago, Milwaukee & St. Paul Railway runs along the south bank of the river near the same place.

The northern part of the section is underlain by older schist and conglomerate and the southern part by younger limestone; the two sets of rocks are separated by a fault. An igneous rock, pegmatite, that is associated with schist in the northern part of the section contains 60 to 80 per cent of potash feldspar, the remainder being chiefly quartz. The pegmatite underlies irregular areas that aggregate 40 acres or more, but it is thought that it may have wider extent beneath a cover of conglomerate. The developments consist of a small shaft, a few small open cuts, and an adit. An average sample of material from a mixed body 40 feet wide exposed in a cut in the SE. ¼ NE. ¼ sec. 18 contained 5.87 per cent of potash (K_2O), but a sample of pink feldspar taken from several irregular bodies at the same locality and aggregating 10 feet in width yielded 12.63 per cent of K_2O.

THE TEXAS POTASH FIELD

SUMMARY OF INVESTIGATIONS

Since 1912, when the first discovery of potash in western Texas was made by Dr. J. A. Udden, interest has centered more and more strongly on this region as a probable commercial source of natural salts of potash. The geologic resemblance between this field and the well-known potash fields of Germany and Alsace had already been recognized, and hopes of discovering potash there had been entertained, so that the discovery itself, though welcome, was no surprise.

The evidence thus far obtained consists solely of brines and cuttings from wildcat wells drilled for oil by methods that provide only qualitative information. Samples have been obtained through the courtesy of drillers, many of whom had scant interest in potash. These samples disclosed the presence at many widely scattered localities of polyhalite ($MgSO_4.K_2SO_4.2CaSO_4.2H_2O$), one of the common potash minerals in the German deposits.

With the extension of wildcatting more wells yielding potash cuttings have been drilled and the extent of the area in which potash is known to occur has been increased. No quantitative information, however, is available, upon which a commercial judgment may be based, for nothing is yet known about the thickness, quality, and extent of individual potash-bearing beds, though it is known that some material of commercial grade is present.

The location of the Texas potash field with respect to other domestic sources of potash and to certain trade centers is shown on the accompanying map of the United States (fig. 11). The location of the individual wells with respect to counties and railroads is shown in the map of western Texas and adjoining territory (Pl. I). The better well records are shown graphically in Plate II. It should be noted that this diagram shows only the depths from which potash-bearing material was taken but not the thickness of the respective potash beds. The apparent repetition of potash strata in these wells may be due in part to the recovery at lower depths of material dislodged from a bed nearer the surface.

The following table gives the names and general location of the potash-bearing wells shown on the map, together with some potash data.

Potash-bearing wells in western Texas, 1923

No. on map	Name of well	County	K_2O in sample (per cent)	K_2O in soluble salts (per cent)	Remarks
1	Spur	Dickens	----------	5.4	Brine sample. Original potash discovery by Udden.
2	Boden	Potter	----------	9.2	Crystals of red salt.
3	Miller	Randall	----------	6.1 10.5	Salts from different depths.
4	Bryant	Midland	----------	8.9	
5	Burns	Dawson	11.95 15.20	21.1 23.2	Do.
6	River	Ward	9.03	14.4	Best sample. (See Pl. II.)
7	Means	Loving	11.21	16.1	Do.
8	McDowell No. 4	Glasscock	7.5	9.95	Do.
9	G. A. Jones	Borden	----------	22.9	Practically pure polyhalite.
10	Cliffside	Potter	Traces		U. S. Geol. Survey well. Did not completely penetrate salt beds.
11	St. Rita group (wells 1-5, 7-9).	Reagan	9.75	14.17	Best sample. (See Pl. II.)
12	Newnham	Ector	----------	----------	Two wells by Farmers Oil Co. Salts not reached.

CURRENT INVESTIGATIONS

In 1923 and the early part of 1924 efforts were made to procure samples from all wells being drilled in the area that was believed to contain potash, and in addition brines from a number of lakes were tested. The data gathered from these sources may be conveniently grouped according to counties.

Andrews County.—Samples analyzed from salts taken from Lost Lake in sec. 9, block A-36, Andrews County, showed merely traces of potash in the soluble salts. A sample of brine from Lake Shafter showed 0.3821 gram of salts per cubic centimeter, with 2.73 per cent of K_2O in the soluble salts. This is a strong brine, and the percentage of potash is significant but by no means comparable to that of the brine now being utilized at Searles Lake, Calif.

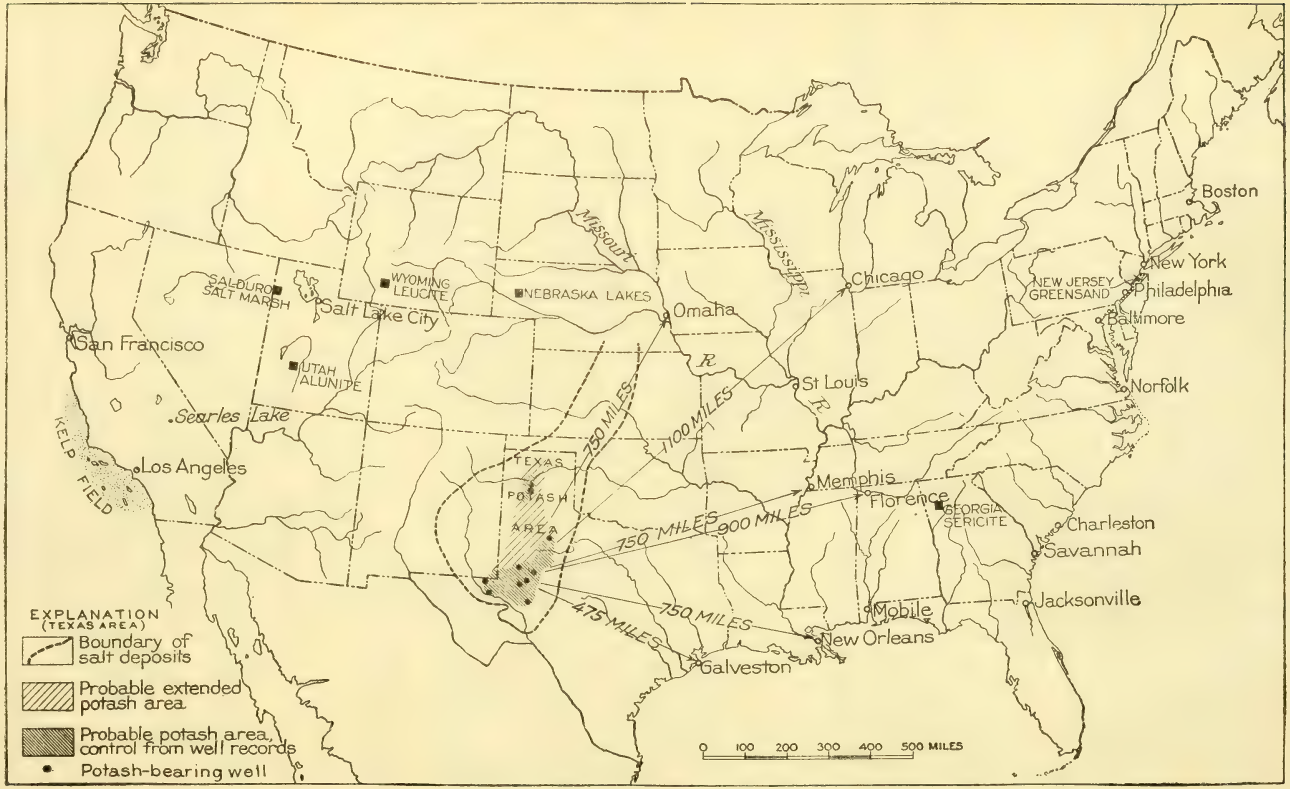
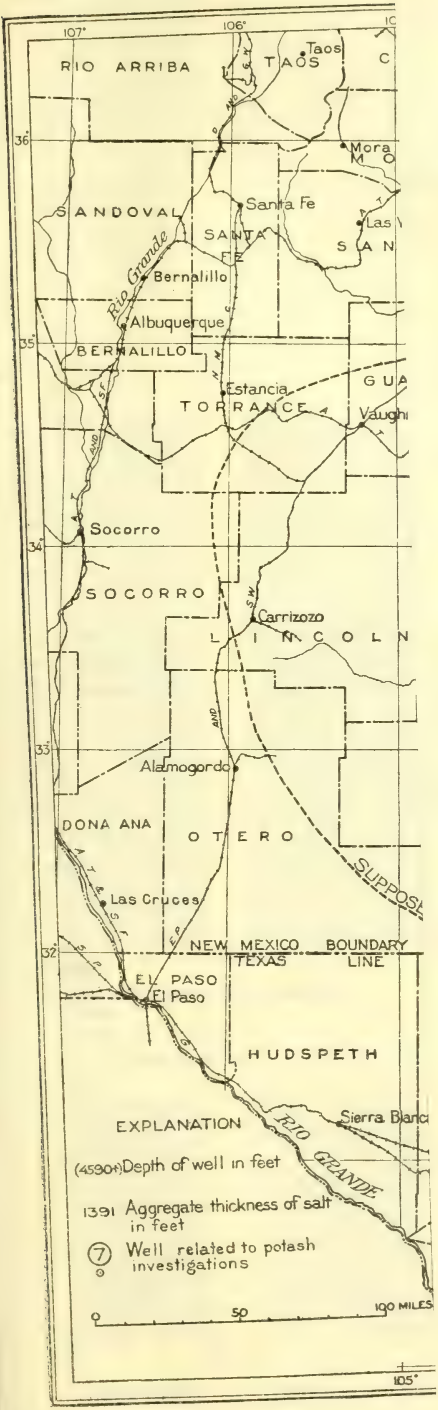
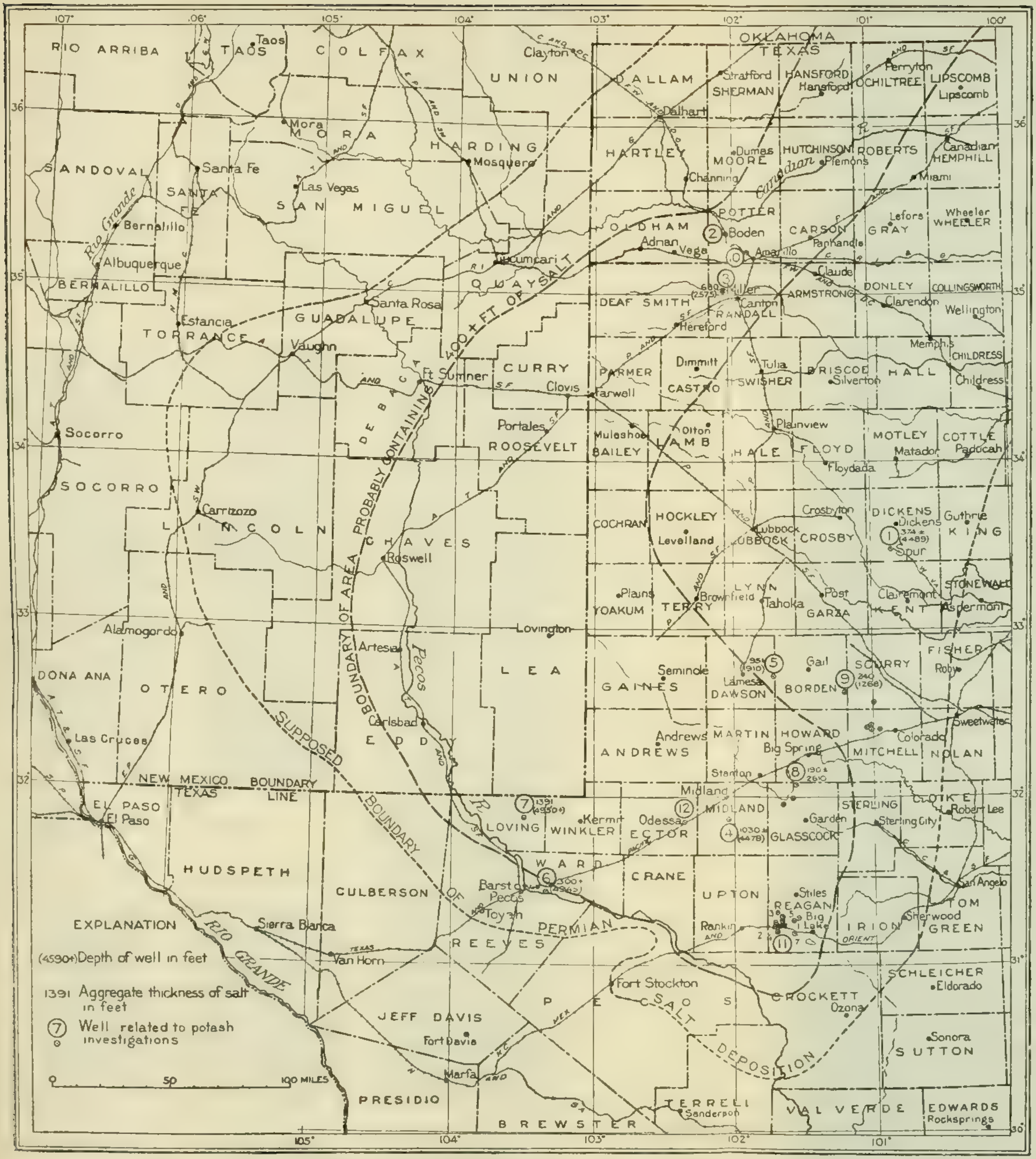


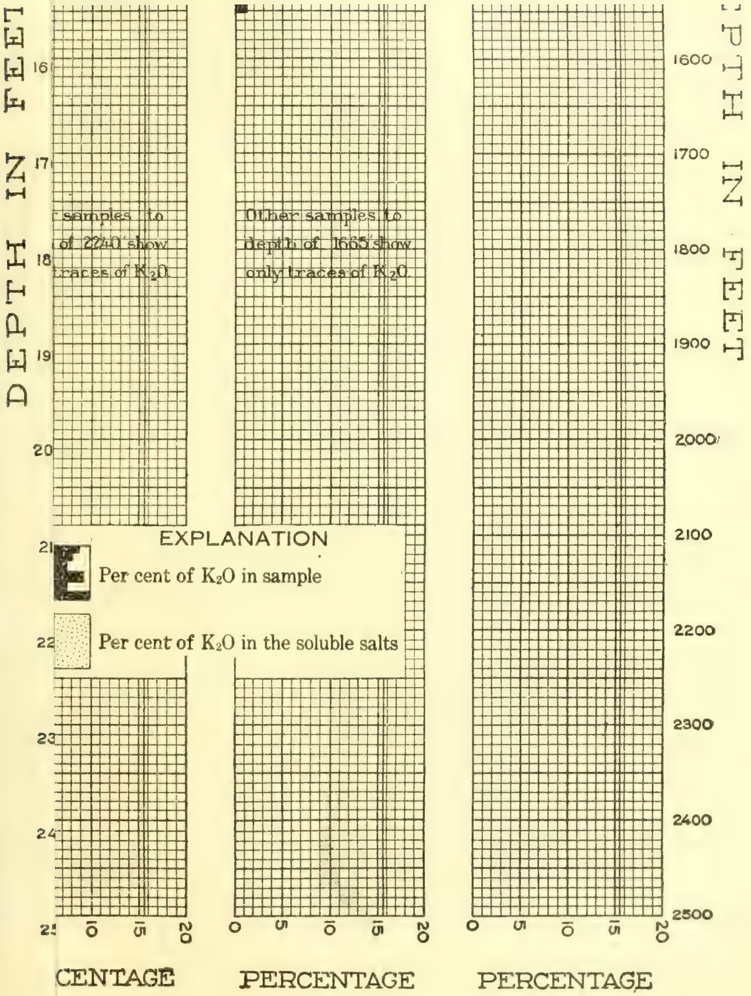
FIGURE 11.—Map of the United States showing the location of the Texas potash field and of other sources of potash



MAP OF WESTERN TEXAS AND

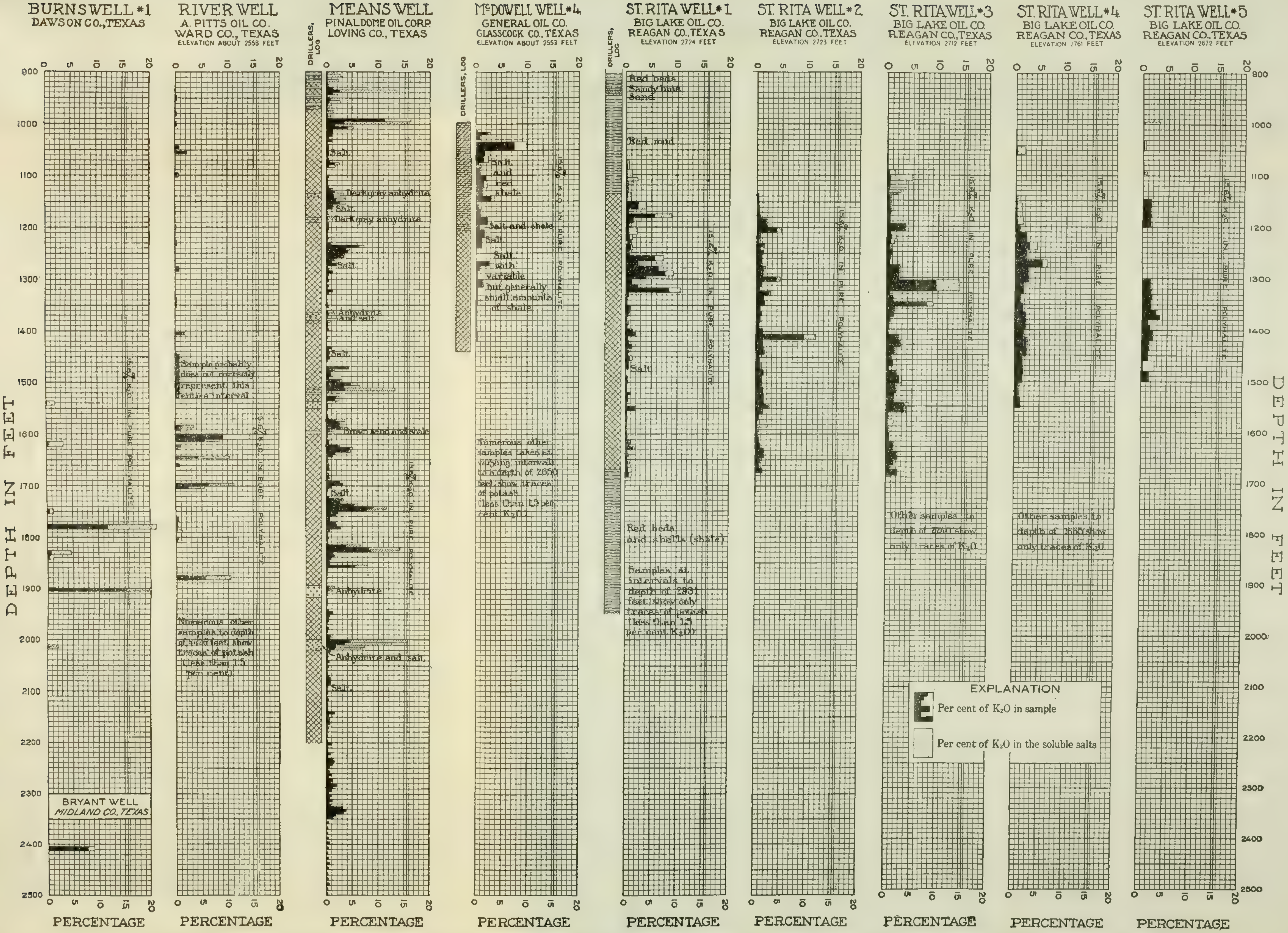


MAP OF WESTERN TEXAS AND ADJOINING TERRITORY, SHOWING THE LOCATION OF WELLS THAT HAVE FURNISHED POTASH DATA



ACTER OF MATERIAL PENETRATED

9786°—26. (Face p. 180.) No. 2



DEPTHS AT WHICH POTASH HAS BEEN FOUND IN WESTERN TEXAS, PERCENTAGE OF POTASH PRESENT, AND CHARACTER OF MATERIAL PENETRATED

Dawson County.—A sample of brine from the Burns well No. 1 (No. 5 on map), in Dawson County, was found to be fairly concentrated, containing 0.2684 gram per cubic centimeter of soluble salts, in which K_2O amounted to 1.91 per cent. A sample of polyhalite taken from this well (lump of about 5 grams) was found upon analysis to contain 15.2 per cent of K_2O, equivalent to 23.2 per cent in the soluble salts. This is the highest-grade Texas sample yet analyzed at the Geological Survey. As the theoretical potash (K_2O) content of polyhalite is 15.6 per cent, it is evident that the material from which this sample was taken is practically pure polyhalite. It is also plainly of commercial grade, as it compares very favorably in potash content with the raw salts mined in Germany, which generally range from about 9 to 16 per cent K_2O, as well as with the general run of raw salts mined in Alsace, which average not over 18 per cent K_2O. In this connection it may be noted that a selected sample of cuttings from the G. A. Jones well, in Borden County (see table and map), ran 22.9 per cent of K_2O in the soluble salts.

Ector County.—The Newnham well No. 1–A, near Odessa, Ector County (No. 12 on map), drilled by the Farmers Oil Co., of Lancaster, Pa., has been visited from time to time by the Survey representative. At last accounts drilling with standard tools was stopped above the salt beds at a depth of about 970 feet, pending the settlement of financial difficulties of the company in its home State. Since the death of H. O. Hartzell, president of the company, which occurred early in 1924, reorganization has been in progress. It is expected that work may be resumed with a core-drilling machine during the current year.

Howard County.—Samples have been analyzed at the Geological Survey from three lakes in Howard County, located as follows: No. 1, secs. 13 and 14, T. 1 S., block 35; No. 2, sec. 12, T. 1 S., block 35; No. 3, secs. 13 and 14, T. 1 S., block 35. A sample of salts taken from the south side of the Texas & Pacific Railway in sec. 13, T. 1 S., block 35, was also analyzed. This salt sample contained merely a trace of potash. The brines from lakes Nos. 1 and 2 were very dilute and their potash content insignificant. Brine from lake No. 3 was considerably more concentrated and contained appreciable amounts of potash, though probably not enough to have commercial importance.

Hudspeth County.—Samples of salt submitted to the Geological Survey from a salt lake on survey No. 335, in Hudspeth County, were found to contain only traces of potash. The salts consisted chiefly of sodium chloride with some sodium sulphate.

Kent County.—Earthy material from a locality near Girard, in Kent County, yielded upon analysis only a trace of potash.

Midland County.—Samples of salt and of brine from the salt lake in sec. 12, block 38, about 13 miles south of Midland, Midland County, yielded on analysis only insignificant amounts of potash, although the brine was strongly concentrated. A sample of brine from Peck's Lake, in sec. 31, block 37, in the same county, which was considerably more dilute, yielded similar results.

Mitchell County.—Samples have been analyzed in considerable number from 10 wells in Mitchell County, located as follows:

Wells in Mitchell County, Tex.

Name	Location	Best sample		Depth (feet)
		K_2O in sample (per cent)	K_2O in soluble salts (per cent)	
Butler No. 1	T. 1 N., block 28, sec. 23, Texas & Pacific Ry. survey.	0.29	0.41	993-1,004
Kelsey-Badgett No. 1	Block 27, sec. 33, Texas & Pacific Ry. survey	.68	.74	1,010-1,020
A. L. Miller No. 1	T. 1 N., block 28, sec. 22, Texas & Pacific Ry. survey.	.56	1.90	833-845
H. C. Miller No. 1	Not given	.56	.60	1,030-1,120
Miller No. 2	T. 1 N., block 28, sec. 22, Texas & Pacific Ry. survey	4.24	4.89	917-923
		2.35	2.51	930-937
		3.82	6.83	1,000-1,018
Morrison No. 1	T. 1 N., block 28, sec. 29, Texas & Pacific Ry. survey.	.29	.41	1,325-1,340
Morrison No. 2	T. 1 N., block 28, sec. 27, Texas & Pacific Ry. survey.	.46	3.54	1,225-1,238
Morrison No. 3 A	T. 1 N., block 28, sec. 33 (?), Texas & Pacific Ry. survey.	.52	1.05	930-938
Morrison No. 5	T. 1 N., block 28, sec. 21, Texas & Pacific Ry. survey.	.44	.75	927-940
O'Neal No. 1	T. 1 N., block 28, sec. 21, Texas & Pacific Ry. survey.	.34	.64	945

Practically all the samples analyzed from these wells show small amounts of potash, but except in the sample taken from a depth of 917 to 923 feet in the Miller well No. 2 these amounts are insignificant. Even the sample cited is low in potash as compared with those listed in the preceding table.

Reagan County.—Interest has centered on the wells in Reagan County during 1923 for two reasons. The potash discovery in the Santa Rita No. 1 well (No. 11 on map) of the Texon Oil & Land Co., which has been announced in previous statements of the Geological Survey, extended the area of known potash occurrence nearly 50 miles southeastward. Then the discovery of oil in this same well at a depth of 3,055 feet caused considerable local excitement and led to the drilling of other wells in the same general region. Two of these, Santa Rita Nos. 2 and 3, drilled within 800 feet of each other and of Santa Rita No. 1, have been discussed in Press Notice 16953, issued by the Geological Survey. Their potash records are shown graphically in Plate II. They represent the first instance of wells drilled near together in Texas disclosing significant amounts of potash. Although the information that they furnish is purely qualitative, they suggest strongly that a fairly continuous bed of potash of commercial quality may be present there at a depth not greater than 1,500 feet. They are of further interest in that they also found oil. These three wells are now controlled by the Big Lake Oil Co., a concern formed by the Texon Oil & Land Co. in conjunction with the Transcontinental Oil Co. A railroad station and settlement named Texon has been established on the Kansas City, Mexico & Orient Railroad near these wells.

Santa Rita well No. 4, which is in sec. 35, block 1, south of the railroad, has furnished some 29 samples that have been analyzed for potash at the Geological Survey. Those taken between depths of

1,210 to 1,552 feet show significant amounts of potash as follows, though none of them may be considered rich.

Potash-bearing samples from Santa Rita well No. 4, Reagan County, Tex.

Depth (feet)	Soluble salts in sample (per cent)	K_2O in sample (per cent)	K_2O in soluble salts (per cent)
1,210–1,230	96.70	2.13	2.20
1,230–1,245	67.40	2.98	4.43
1,245–1,265	99.30	2.01	2.02
1,265–1,280	82.90	5.42	6.53
1,280–1,309	97.10	2.64	2.72
1,309–1,330	94.52	1.93	2.04
1,330–1,348	93.20	1.06	1.13
1,348–1,367	95.90	1.61	1.68
1,367–1,398	93.20	2.03	2.18
1,398–1,414	98.30	1.88	1.91
1,414–1,430	91.60	2.36	2.58
1,430–1,451	89.50	2.24	2.50
1,451–1,470	97.10	1.46	1.51
1,470–1,489	95.20	1.74	1.83
1,489–1,512	96.90	1.67	1.72
1,512–1,531	96.40	.70	.73
1,531–1,552	96.30	1.06	1.10

Santa Rita well No. 5, in the same general region but in sec. 13, block 2, north of the railroad, has furnished 24 samples that have been analyzed by the Geological Survey. Of these, 17, ranging in depth from 1,150 to 1,500 feet, were found to contain significant though relatively small amounts of potash—that is, 1 per cent or more of K_2O in the sample. The richest sample came from a depth of 1,370 to 1,380 feet and contained 3.36 per cent of K_2O, equivalent to 3.58 per cent in the soluble salts.

The Santa Rita well No. 8, in sec. 3, block 2, near No. 5, has furnished 37 samples that have been analyzed for potash. Of these, 17 have shown more than 1.5 per cent of potash, as listed in the following table:

Potash-bearing samples from Santa Rita well No. 8, Reagan County, Tex.

[Altitude, top of well, 2,732 feet]

Depth (feet)	Soluble salts in sample (per cent)	K_2O in sample (per cent)	K_2O in soluble salts (per cent)
1,180–1,195	90.30	1.84	2.03
1,220–1,230	69.80	2.78	3.98
1,235–1,245	75.80	5.58	7.36
1,245–1,260	77.40	4.86	6.28
1,260–1,280	88.10	4.20	4.76
1,280–1,290	76.70	5.92	7.70
1,300–1,310	77.40	5.88	7.60
1,380–1,390	92.20	3.14	3.41
1,390–1,410	92.90	3.17	3.41
1,410–1,430	97.50	2.11	2.17
1,430–1,450	97.70	2.32	2.38
1,450–1,470	96.30	2.57	2.67
1,470–1,490	51.90	4.80	9.25
1,490–1,510	46.10	5.48	11.89
1,510–1,530	98.30	3.94	4.00
1,530–1,550	94.80	2.87	3.03
1,550–1,570	96.70	3.22	3.33

The Geological Survey has also analyzed 11 samples from Santa Rita well No. 7, altitude 2,837 feet, in sec. 27, block 1, southeast of

No. 8. These came from depths of 1,252 to 1,380 feet. All showed traces of potash but none as much as 1 per cent in the sample. The Santa Rita well No. 9, altitude 2,722 feet, 1,000 feet east of No. 1, is reported as a 1,000-barrel oil well, but the details regarding the potash found in it are not now available for publication.

Reagan County has thus far furnished more definite evidence of the presence of potash than any other county in southwestern Texas and may therefore be regarded as a favorable region for core-drilling tests, but it is probable that other counties to the west and northwest may yield equally good or better evidence upon further exploration.

Scurry County.—The Moore well No. 1, 1½ miles south of Ira, in Scurry County, has furnished 75 samples that have been analyzed at the Geological Survey. All of these show some potash, but in none is there more than an insignificant amount. The best sample, taken from a depth of 930 to 940 feet, yielded 0.71 per cent of K_2O, equivalent to 1.19 per cent in the soluble salts. There were several samples, however, that contained potash of better quality than the sample just cited but in smaller proportion. The best of these contained only 0.36 per cent of potash, but this represented 6.92 per cent of the soluble salts. It came from a depth of 650 to 670 feet.

Terrell County.—Some 37 samples from the Folsom well No. 1, in sec. 148, block D-7, 10 miles south of Watkins, in Terrell County, have been analyzed by the Geological Survey. None of these showed more than traces of potash.

INTERPRETATION OF RESULTS

The unsatisfactory nature of samples taken with churn-drill or rotary outfits, such as were used in the wells mentioned above, especially if the interval between the samples is greater than 5 feet, is readily apparent. The mixing of the material effectually prevents the recognition of individual beds unless they are very thick. The dangers of "salting" lower beds by material from higher levels and of misinterpretation caused by "hangover bailings" are ever present. The necessary water in the hole, by its solvent effect on salts of differing solubilities, may either enrich or impoverish the sample, and this effect is intensified if the water is in contact with the sample for any great length of time. The results indicated in Plate II are therefore to be regarded as suggestive rather than as giving any accurate idea of the number, character, and quality of the individual beds.

The analyses recorded in Plate II have been made on the arbitrary laboratory basis of 1 gram of sample to 100 cubic centimeters of water. Commercial practice may find some other proportion more suitable. According to Steiger,[3] 1 gram of polyhalite contains 0.452 gram of $CaSO_4$, 0.199 gram of $MgSO_4$, 0.289 gram of K_2SO_4, and 0.060 gram of water. Although the presence of other salts will slightly change the figures, 100 cubic centimeters of pure water at 25° C. will dissolve 0.208 gram of $CaSO_4$. This dissolved $CaSO_4$, added to the easily soluble $MgSO_4$ and K_2SO_4 in 1 gram of the mineral, will make 0.696 gram, or 69.6 per cent of the soluble salts. By calculation we find that the 15.6 per cent of K_2O in pure polyhalite becomes 22.4 per cent of K_2O in the soluble salts. If a larger or smaller amount of water is used this figure will vary accordingly. The 22.9 per cent of K_2O at the Jones well and the 21.10 and 23.20 per cent of K_2O at the Burns well (p. 179) probably indicate the presence of pure polyhalite. There seems to be no good reason why the occurrence of potash in Texas should be limited to the mineralogic combination found in polyhalite, though both chemical and optical examinations have thus far failed to identify other salts. Additional types corresponding with the more common German salts are to be confidently expected.

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[3] Steiger, George, Potash salts of western Texas: Chem. and Met. Eng., vol. 26, pp. 175-176, Jan. 25, 1922.

NEED FOR FURTHER EXPLORATION

Core drilling is needed to give accurate information. Drillers are urged to consider potash as well as oil in sinking new holes and to provide for coring the salt beds. Two attempts of this sort already made have been abandoned, at least temporarily, before the salt beds were reached. These failures were due in part to the lack of recognition by the drillers of the necessity of keeping the well properly cased.

A drilling solution other than water will be needed for the coring of the salts; otherwise the core may be damaged or lost. The Germans have used a 30 to 35 per cent solution of magnesium chloride for this purpose with apparently satisfactory results. Magnesium chloride, however, would be expensive in western Texas, and it is probable that a saturated brine such as may be obtained from some of the lakes in the region may serve the purpose.

The negative result at the Geological Survey's boring at Cliffside, which was thought to be favorably located, shows that barren areas may be interspersed with possibly productive areas. The only way in which the productive areas can be delimited is by drilling, and it may be necessary to drill many holes before the essential facts can be gathered. Gale[4] notes that when systematic exploration for potash began in Alsace more than 100 deep borings were put down, 95 of which penetrated rock salt. Of these only 17 found potash layers. If this experience is any criterion for Texas it will be a long time before much will be known of the commercial value of the potash beds there from wildcat operations. Some far-sighted company with a view to future rather than immediate returns, or even the Government itself, should undertake a systematic campaign of investigation. It is believed that the evidence already obtained points strongly to the probability of deposits of commercial value and would justify the needed expenditure.

REVIEW OF AMERICAN POTASH SITUATION

POTASH RESOURCES OF THE UNITED STATES

In 1910 the German Government passed a law virtually creating a Government potash monopoly with absolute control over both production and prices. This act was accompanied by a sharp advance in price to American consumers, despite contracts then existing and antedating this act. This situation led to determined efforts on the part of the United States Government to find cheap domestic sources of potash, and in 1911 Congress provided for investigations of domestic potash resources by both the Geological Survey and the Bureau of Soils. These investigations, which have continued to the present day, have disclosed domestic resources of the following types:

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[4] Gale, H. S., The potash deposits of Alsace: U. S. Geol. Survey Bull. 715, pp. 17-55, 1920.

Salt beds in western Texas and adjacent parts of New Mexico and Oklahoma. Beds of potash are known to be associated with these at a number of widely scattered localities.

Natural brines in California, Utah, Nevada, Nebraska, and Texas.

Insoluble materials such as alunite in Utah, leucite in Wyoming, greensand in New Jersey, and sericite in Georgia.

By-product potash from salt and soda works in California and Nevada and from cement mills and blast furnaces in various parts of the country.

Organic sources such as kelp from the Pacific coast, molasses and beet-sugar refinery wastes, wool washings, and wood ashes.

All these sources or types of resources except the first were drawn upon during the war and produced potash under the stimulus of high prices. With the fall in prices since the war most of the plants have had to close, and to-day a single company, the American Trona Corporation, at Searles Lake, Calif., which is a subsidiary of a foreign corporation, produces practically all the domestic potash. The amounts of potash produced as a by-product by 11 other plants are comparatively small.

Searles Lake.—Searles Lake is a dry desert basin containing a body of salt estimated to have an area of 10 to 12 square miles and averaging about 75 feet in thickness. The porous salt is saturated with brine, which contains most of the potash and borax in solution. It has been estimated that this body contains 20,000,000 tons of water-soluble potash salts. If this were all made available it could supply the need of this country at the current rate of consumption about 90 years. As under normal conditions it is drawn upon to supply only a fraction of the country's needs at any given time, its life may be expected to be many times longer than the figure stated.

Nebraska lakes.—In western Nebraska there are many alkaline lakes of varying size. More than a hundred of these, known to contain potash in recoverable amount, are scattered over an area of some 800 square miles and have an aggregate area of more than 6,097 acres. In 1918, the year of maximum production, these lakes supplied 53 per cent of the potash produced in the United States, but as their total estimated content of pure potash (K_2O) is only about 215,000 tons, their life would be much shorter than Searles Lake in case of any exceptional or prolonged draft. They are now inactive.

Other salines.—Great Salt Lake and Salduro Marsh, in Utah, which yielded potash during the war, and certain recently described lakes in Texas that are not yet productive are probably promising sources that could be drawn upon in emergency. Estimates of quantity for these sources are not available, but the quantities are undoubtedly large.

Alunite.—Alunite in Utah was a source of potash production during the war but was among the earliest sources to be abandoned when prices fell.

Kelp.—Kelp, which supplied 9 per cent of the country's potash production in 1918, is now not being used.

By-product potash.—About 12 per cent of the potash produced and sold in 1918 was by-product material from mineral and organic sources. Production from these sources continues, but on a greatly reduced scale, although the ratio of such potash to the total production has been slightly increased.

DIFFICULTIES WITH PRESENT SOURCES

With the exception of the American Trona Corporation, all enterprises utilizing natural brines have had to cease operations. Brines require evaporation and elaborate chemical treatment for the separation of their constituent salts. These requirements raise the cost of development and operation above the limits imposed by foreign competition. The same may be said of extraction from alunite, greensand, leucite, sericite, and kelp. By-product potash also requires expensive equipment and treatment, which operating companies are loath to install under existing low prices of foreign potash. Many of those that had made the necessary installations have not found it profitable to continue operations.

CHEAP NATURAL SOURCE NEEDED

What is needed is a plentiful source of natural salts which may be sold for direct application to the soil without chemical treatment or which could be readily refined to more concentrated form for cheaper transportation. It is believed that the potash disclosed in the well cuttings from western Texas, if sufficiently plentiful, will meet this need. The mineral polyhalite, which is the only potash-bearing mineral yet identified from the region, is adaptable to just these purposes.

FAVORABLE CONDITIONS IN TEXAS FIELD

The discoveries in Texas, which were made in part in cooperation with the State Bureau of Economic Geology and Technology, show that many similarities in geologic conditions exist between that region and the potash-bearing fields of Germany and Alsace. The details of these discoveries have been set forth above. The percentage of potash in the Texas field, according to samples thus far found, ranges from a fraction of 1 per cent to 15.2 per cent K_2O in the original sample, equivalent to 23.2 per cent in the soluble salts. The better-grade material is therefore comparable in richness to the crude salts mined in Germany and Alsace.

In both Germany and Alsace the potash is mined by shafts and galleries. The maximum depth is about 5,000 feet in Germany and 3,000 feet in Alsace, but the usual depth does not exceed 3,900 feet and 1,800 feet respectively. So far as the evidence at hand shows, the Texas beds are not so deep, the range there seeming to be between 1,000 and 2,400 feet.

In view of the experience in the Kansas rock-salt mining industry the opening up of the Texas deposits would appear to be not unduly expensive. In the rock-salt mines of Kansas the salt is mined by shafts and galleries at a depth of about 1,400 feet. According to the latest figures published by the Geological Survey, these mines in 1923 produced about 530,000 tons of rock salt, and the average price of rock salt for the entire country that year was $3.73 a ton. There would seem to be no reason why potash salts in Texas might not be mined at comparable costs. Recent quotations on kainite from Germany carrying 14 to 16 per cent K_2O are $7.33 a short ton. These figures suggest that the Texas salts might be mined with a margin of safety to meet transportation charges to eastern markets. Texas salts would have to meet the competition of foreign salts in these markets, but in the Central States, where a large demand must sooner or later develop, the Texas salts would have a distinct advantage.

POSSIBLE EFFECTS OF COMMERCIAL POTASH IN TEXAS

The total consumption of potash in the United States for 1923 and details of production and importation have been given on pages 167–173. With the market for potash chiefly in the southeastern Atlantic States and somewhat remote from Texas, it is not presumed that Texas potash, even if demonstrably present, could at once displace foreign potash, though from the comparative figures for rock-salt mining in Kansas cited above it is thought that there would be a fair chance for the industry to make a satisfactory beginning. The mere knowledge of the existence of commercial potash in Texas would tend to keep foreign prices down and thus insure cheap potash to the farmer. With the development of the demand for fertilizers which must come sooner or later from the middle western grain-producing States, the Texas potash would be in a more favorable situation than foreign potash, which would have to bear additional freight charges from the seaboard to the interior.

Searles Lake potash, which is already finding a ready place in the eastern markets, would doubtless continue to hold that place and would be possibly unfavorable to the development of Texas potash. The Searles Lake deposit, moreover, is well situated to take care of the demand that may be expected to increase for fertilizers in the Pacific fruit and grain growing districts, which are more remote from the Texas field. It is therefore not believed that the development of a potash industry in Texas would seriously affect the marketing of Searles Lake potash.

PROPOSED LEGISLATION

When Congress adjourned on June 7, 1924, there was pending before the House a bill (S. 3047), which had already passed the Senate, where it was introduced by Senator Sheppard, of Texas, providing for the expenditure by the Geological Survey of $500,000 annually for five years for the exploration of natural potash salts in the United States. The bill also provides for the expenditure by the Bureau of Soils of $50,000 annually for the same period for the investigation of by-product potash production from industrial wastes and refractory natural materials such as greensand and leucite. Provisions for reimbursing the Government for the cost of exploration and for the prevention of profiteering are also included in the bill. If this bill should pass it should be possible to test adequately by core drilling a considerable portion of the Texas potash field and to obtain quantitative information upon which commercial judgment regarding the contained potash beds might be based.

There was also pending in the same session a bill (S. 3005), introduced by Senator Ladd, of North Dakota, designed to correct certain abuses that have arisen in connection with the present potash leasing law. The bill repeals the act of October 2, 1917 (40 Stat., p. 297), and extends to potash certain provisions of the act of February 25, 1920, relating to "coal, phosphate, oil, oil shale, gas, and sodium on the public domain."

NOTES ON FOREIGN POTASH

GERMANY

The following notes relating to the German potash industry have been abstracted chiefly from statements emanating from W. T. Daugherty, assistant trade commissioner at Berlin, and published from time to time by the Bureau of Foreign and Domestic Commerce in Commerce Reports, trade bulletins, or other papers. Some items from trade journals credited to other sources are also included.

Citing the annual statement of the Deutsche Kaliwerke (one of the members of the potash syndicate) for 1922, Mr. Daugherty writes under date of April 24, 1923:

> The potash syndicate sold 1,295,579 tons of pure potash in 1922, against 921,147 tons in 1921 * * * German sales were distributed in amount of 74.4 per cent inland and 25.6 per cent abroad. Inland sales amounted to 963,599 tons, against 768,494 tons in 1921, or an increase of 25.4 per cent. The export sales amounted to 331,980 tons, against 152,652 tons in 1921, or an increase of 117.5 per cent.

On the strength of this increased business the Deutsche Kaliwerke proposed a dividend of 100 per cent for the year 1922, as against 20 per cent for the previous year.

In contrast with 1922 the year 1923 was marked by great irregularity in the German potash industry. Early in the year production was maintained at nearly the normal level, but sales fell off from March to the middle of May to such an extent that artificial means of stimulation were resorted to. In midsummer sales were abnormally high, but in the fall a severe depression set in which has held over into the present year.

The situation in 1923, as analyzed by Mr. Daugherty in communications dated January 4 and 8, is as follows:

> The German potash industry suffered in 1923 from the ill effects of the confused economic situation. Total sales of potash, which is an index to production, amounted to only 885,957 tons in 1923, against 1,295,579 tons in 1922, a decrease of about 32 per cent; inland sales amounted to 542,736 tons K_2O in 1923, against 963,599 tons in 1922, while foreign sales amounted to 343,222 tons in 1923, against 331,980 tons in 1922.
>
> Decreased inland sales are attributed partly to the reluctance of farmers to purchase on account of currency depreciation, and partly to the fact that dealers had available considerable stocks from the previous year. * * *
>
> Alsatian competition is reported to have been felt, especially in Czechslovakia. Alsatian potash production is said to be sufficient to cover 12 per cent of the world consumption at present.
>
> Inland price changes were frequent during the course of 1923 until September 24, when they were put on a gold basis. Prices prevailing up to January 1, 1924, were those which went into effect October 9, 1923.

The price increases are tabulated as follows:

Inland prices of German potash salts effective October 9, 1923, and January 1, 1924

[Prices in gold marks per double centner (220.46 pounds)]

Kind	K_2O (per cent)	Oct. 9, 1923	Jan. 1, 1924	Increase or decrease in January (per cent)
Carnallite	9–12	6.59	6.89	+4.5
Kainite	12–15	7.92	8.17	+3.1
Fertilizer salts	18–22	11.81	11.25	−4.8
Do	28–32	15.18	14.50	−4.5
Do	38–42	19.55	15.75	−20.0
Chloride	50–60	21.84	27.00	+23.0
Sulphate	Over 42	36.85	31.25	−15.0

In connection with the new prices, which became effective January 1, it is observed that the low-percentage salts, carnallite 9–12 per cent and kainite 12–15 per cent, were increased by an average of 3.8 per cent over the October 9 price; the intermediate percentages—that is, 20 per cent and 30 per cent salts—were decreased by an average of 4.65 per cent; fertilizer salts decreased by 20 per cent; potassium chloride increased by about 23 per cent; while potassium sulphate was decreased by 15 per cent.

The greatest significance of these price changes to German agricultural consumers was the 20 per cent decrease of 40 per cent fertilizer. About 75 per cent of the total consumption of potash salts by German agriculture is the 40 per cent grade. * * *

The average cheaper prices for potash now are said to impose a considerable burden on the works, as costs of materials such as coal, iron, wood, oil, etc., are higher now than then.

Wages in the potash mines were 3.10 [gold] marks per shift of seven and one-half hours at the beginning of 1924.

The change in prices made effective on January 1, as above indicated, was the outcome of much discussion and dissension in the potash industry. The controversy even led to the resignation of the general director of the potash syndicate. One faction, led by the Wintershall concern and the works of the Aktien Gesellschaft Deutsche Kaliwerke, together controlling about 43 per cent of the total production of German potash, has stood for a decrease rather than an increase of prices. These groups are mass producers, using wholesale methods of production. They admittedly can stand the strain of lower prices for this reason. The other faction, comprising most of the remaining 57 per cent of the industry, is not concentrated in the manner of the two groups above mentioned. It includes more generally the smaller producing groups, employing smaller-scale methods with corresponding higher costs of production. The victory of the 43 per cent faction in this controversy may be interpreted as intent to support the forced reduction of prices of German potash to American consumers put into effect about the middle of May, 1923.[5]

One result of the controversy and of the general reduction in prices has been the discharge by the potash syndicate of large numbers of workers. In spite of long-term credits offered to the farmers in Germany to increase potash sales and of a considerable revival in trade during the month of February, reports from Germany indicate that conditions in the industry are still far from satisfactory. Advices [6] received in New York state that some of the large potash mines have discontinued operations, having found it impossible to operate at a profit and sell at prices now prevailing for potash salts. Competition from Alsatian potash has been keen for the last year or more, and this has forced curtailment by German producers—in fact, those whose costs of production were high have been compelled to close their mines. It is not expected that this reduction of output will have any effect on the local German markets, as supplies and offerings for domestic trade are reported to be ample for all needs.[7]

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[5] Commerce Repts., Mar. 3, 1924.

Two elements of the situation deserve further mention, namely, the cost of supplies, particularly brown coal, and the cost of labor. Mr. Daugherty reports from Berlin that the German potash syndicate has protested to the Federal Minister of Economics that prices of brown coal, on which it is dependent for 95 per cent of its coal consumption, are now so high that it can scarcely bear the strain of low selling prices for potash. Brown coal now costs in Germany, the syndicate alleges, 41.38 per cent more than it did before the war, while inland potash prices have been fixed at an average of 15 per cent below pre-war levels. Labor and wages are the cause of a controversy. The employers maintain that the only way to tide over the present crisis and pay wages on a gold basis is to increase the number of working hours. Employees are unwilling to adopt this point of view.

Germany's unmined potash resources, according to one estimate recently published by the German Foreign Office,[8] contain 2,000,000,000 tons of K_2O.

A new discovery of potash in Germany is reported by F. R. Stewart, American consul at Bremen. According to the press, a well driven to a depth of 1,400 meters at Klein-Bühren, on the Elbe, encountered a stratum of potash several hundred meters thick, under which, after further drilling, petroleum was discovered. Exploitation of the deposit of potash is expected to begin at an early date.

ALSACE

A brief but comprehensive account of the Alsatian potash field and industry has been published by Gale.[9] Before the war, when the mines were operated under the German potash syndicate on the quota basis, the highest amount of crude salts extracted, according to Mennecke,[10] was about 350,000 tons of crude salt. Since the mines have come under the management of French directors the production has been greatly increased.

The year 1923 has furnished the largest production up to the present time.[11] In that year the mines of the Department of Haut-Rhin yielded 1,568,000 metric tons of sylvinite (crude salts ?), a figure that exceeds by 28 per cent that for 1922, which itself exceeded those of previous years. A comparison of the quantities of merchantable potash salts of various grades produced in 1921 to 1923 is given in the following table:

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[6] Chem. and Met. Eng., May 5, 1924, p. 721.

[7] Additional details regarding prices and curtailment of potash production are given in an article entitled "The German potash crisis" (Am. Fertilizer, vol. 60, pp. 35–37, Feb. 23, 1924).

[8] Cited in Chem. and Met. Eng., June 18, 1923.

[9] Gale, H. S., The potash deposits of Alsace: U. S. Geol. Survey Bull. 715, pp. 17–55, pls. 4, 5, 1921.

[10] Mennecke, M., The French potash industry, a lecture delivered at the recent mining exposition at London: Am. Fertilizer, vol. 59, pp. 23–26, Sept. 8, 1923.

[11] Commerce Repts., Mar. 24, 1924, p. 767.

Merchantable potash produced in Alsace, 1921–1923, in metric tons

Kind of salts	1921	1922	1923
Sylvinite, 12 to 16 per cent	319, 450	352, 800	409, 565
Sylvinite, 20 to 22 per cent	231, 240	325, 450	348, 046
Chloride, 30 to 40 per cent	15, 800	69, 670	110, 153
Chloride, 50 to 60 per cent	92, 060	128, 500	158, 278
	658, 550	876, 420	1, 026, 042

In 1923 the potash content of the year's output amounted to 248,528 metric tons, an increase of about 17 per cent over the figure for 1922 (211,675 metric tons), and of 72 per cent over that for 1921 (144,836 metric tons).

The French mines, which comprise in all 17 shafts, are operated in two groups—one including the three groups formerly owned by the Germans and in 1918 sequestered by the French Government and the other the Groupe alsacien of original French-Alsatian ownership. The sequestered groups control 13 of the 17 shafts, and the other group 4.

In February, 1923, according to Leslie E. Woods, vice consul at Strasbourg,[12] a proposal was voted in the French Chamber of Deputies for the leasing of the sequestered groups to a new company for the period of 75 years, the new organization to issue stock which should be offered for subscription in the following proportions to the classes named: Agricultural syndicate and associations, 50 per cent; manufacturers consuming potash, 10 per cent; individuals and communities of Alsace-Lorraine who suffered damages during the war, 5 per cent; the Departments of Haut-Rhin, Bas-Rhin, and Moselle and communities, chambers of commerce, and cooperative insurance societies therein, 15 per cent; holders of shares in sequestered companies which prior to November 11, 1918, belonged to French citizens or Alsatians or Lorrainers who have been reintegrated as French, 15 per cent; staff of the company or sales company thereof and workingmen of the mines of the company, 5 per cent. It was proposed further that the mines should have but one sales agency, that the needs of France must be served before foreign markets, and that the price for which the products shall be offered in France shall not be higher than for foreign customers. At the present time there is a single sales agency for both groups. It is known as the Société commerciale des potasses d'Alsace, at Mulhouse, and has a branch of the same name at New York City.

The year 1922 was a prosperous one in the Alsatian potash industry, as in the German, the outstanding feature being the regularity with which orders were received and the absence of a dull season. The Groupe alsacien on May 19, 1923, declared a dividend of 20 per cent. The sequestered group is reported not to have fared so well.

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[12] Cited under title "United States foremost foreign market for Alsatian potash" in Chem. and Met. Eng., Sept. 17, 1923, p. 557.

The year 1923, which proved a disappointment to the German potash industry, was marked by a substantial gain, as noted above, in the Alsatian industry.

Comparing the output per mine in France with that in Germany, Mennecke makes the following statement:

> The advantage of a limited number of mines is proved by statistics. If we divide the total sales of German potash salts in 1922 by the number of mines in existence, we obtain a figure of output corresponding to 6,140 tons of K_2O per mine. If we do likewise with the Alsatian mines, we obtain a figure of output of 13,118 tons of K_2O per mine, which amount is, of course, the real figure of sales from the Société commerciale des potasses d'Alsace.
>
> One last comparison of figures to prove conclusively the advantageous situation of the French potash mines: When comparing the rates of expansion of the two competitive groups, it is advisable to leave out of consideration the home consumption of both countries in question, namely, France and Germany. From this point of view, we arrive at interesting facts. In 1922 the Germans exported 331,659 tons of K_2O, while we exported 158,295 tons of K_2O. If we work out these figures in proportion to the number of existing mines in Germany and France, we must conclude that the French situation with regard to export trade is relatively much better than the German. In 1922 the Germans exported little more than double the French, notwithstanding the fact of their having 12 times the number of mines.
>
> Under normal conditions, the technical power of the French mines will enable them easily to meet German competition; but conditions are not yet normal.

In France, as in Germany and in the United States, efforts are being made to induce the farmers to use greater quantities of potash fertilizers. Thus a French journal [13] makes the following statement regarding the Alsatian potash industry:

> The Alsatian mines can now compete with the German potash syndicate in every respect. Thanks to energy and considerable State subsidies, the mines of Alsace are able to compete with the best-equipped and most profitable mines of the Kalisyndikat so long as they labor under the disabilities incurred under the law of 1910. Agriculture first, but other branches of French industry also, must extract the greatest advantage from the prosperity of the Alsatian mines and come to their support with a greater demand for their product. This has particular reference to beet-root growers, as well as to cultivators of apples, grapes, fiber plants, grassland, and cereals.

OTHER COUNTRIES

Canada.—D. C. Kerr, American vice consul in charge at Vancouver, British Columbia, reports the recent discovery of important potash deposits in that Province. No details are available regarding the location, character, or extent of these deposits.

It is reported that drilling operations for potash are to be commenced in the near future on Pelee Island, near Chatham, Ontario, by a large Chicago firm.[14] No details are available, but the outcome will be awaited with interest.

Canada is estimated to consume annually 1,200 tons of potash (K_2O), equivalent to 6,000 tons of salts. Nearly all of this is imported from Germany, Alsace, and the United States. Potash production in Canada is merely a side issue, except for the wood ashes exported for other than fertilizer purposes to the United States. Potash is recovered from flue dust in one or two cement plants and from blast-furnace gases, and small amounts are still saved at three beet-sugar factories in Ontario and at certain distilleries. As a by-product of wool scouring it is likely to increase now that the Cooperative Wool Growers are centralizing the yield, and a combing-plant company is projected on similar lines.[15]

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[13] Cited in Am. Fertilizer, p. 33, May 17, 1924.

[14] Chem. and Met. Eng., Sept. 17, 1923.

China.—The bulletin of the China Institution of Mining and Metallurgy for August, 1923, contains an interesting article on the saltpeter industry in China. Small quantities of potassium nitrate are annually produced by the lixiviation of earth scraped from soils in the neighborhood of villages, long manured parts of farmers' fields, the sides of old mud walls, etc. The industry began with the earliest civilization of China and is still practiced in its primitive way. The production of saltpeter, which is carried on at 76 towns in 16 Provinces, is controlled by Government regulation. "Official salt-producing families" are licensed to make the saltpeter and to sell it to designated officials.

Although the Chinese are said to have been familiar with the manufacture of explosives in ancient times, they ordinarily used them only for fireworks, but now saltpeter is used by a variety of industries. Perhaps, on account of the insufficient supply and impurity of the home-manufactured saltpeter, the product is rarely used in large-scale industry in China. Trade reports of the Chinese maritime customs show that large quantities of saltpeter are imported every year. The imports in 1911 to 1914 were as follows:

Chinese net imports of saltpeter, 1911–1914

	Quantity (piculs [a])	Value (haikwan taels [b])		Quantity (piculs [a])	Value (haikwan taels [b])
1911	55,016	544,658	1913	59,937	415,105
1912	64,287	616,259	1914	52,811	378,428

[a] One picul=133⅓ pounds avoirdupois.
[b] One haikwan tael=$0.8873.

Czechoslovakia.—Large deposits of potash, estimated to contain millions of tons, are reported to have been discovered recently in Czechoslovakia.[16] No details and no confirmation of the report are available.

Honduras.—Deposits of potassium nitrate said to be extensive occur in the western part of Puerto Cortes and in the Department of Yor, in the northwestern part of Honduras. The deposits have been worked by natives by crude methods for years. No foreign capital is interested.[17] No details are available.

Saltpeter deposits in Guatemala, examined in 1917 by H. S. Gale, proved to be impregnated earth and soil like those of China described above. It is likely that those of Honduras may prove to be of similar character or possibly cave deposits.

Italy.—Leucite from Italian lavas is assuming some prominence as a possible source of potash. A number of articles on it appearing in trade journals are listed in the bibliography at the end of this report. The following notes are abstracted from a comprehensive article, with discussion, on "The manufacture of potash and other salts from leucite," by J. W. Hinchley.[18]

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[15] Canadian Min. Jour., Jan. 19, 1923.
[16] Oil, Paint, and Drug Reporter, Nov. 19, 1923.
[17] Trade Inf. Bull. 193, Bur. Foreign and Domestic Commerce, Feb. 25, 1924.
[18] Chemistry and Industry, Feb. 15, 1924, pp. 158–168.

Pure leucite may contain as much as 21.5 per cent of potash (K_2O), 23.5 per cent of alumina, and 55 per cent of silica. Ordinarily part of the potash is replaced by other substances such as sodium or magnesium. The leucitic lava of the Rocca Monfina volcano, which is about 30 miles north of Naples, is of higher grade than any other Italian lava, averaging about 10.5 per cent in potash. It covers an area of 80 square miles and is estimated by H. S. Washington to contain 1,008,000,000 metric tons of K_2O, enough to supply the world with potash at the present rate of consumption for 1,000 years.

Leucite is related to the zeolites but contains no water. Its potash is readily replaceable by many other elements, so that its application to water softening and similar purposes is obvious.

Pot experiments with powdered leucite indicate that for some crops the value of leucite is practically identical with that of soluble manures of the same potash content.

Baron Blanc, who has worked for some time on the problem of utilization of leucite, has devised a simple method of electromagnetic separation by which the leucite may readily be separated from its gangue. For chemical treatment the leucite is crushed to grains about one-sixteenth of an inch in diameter. Material finer than this is not suitable for acid treatment because of the propensity of the silica contained in the leucite to gelatinize. It may, however, be used for direct application to the soil. Without going into the chemical discussions given in the article it may be stated that by using the granular leucite and circulating dilute acids the difficulty of gelatinization is overcome. Alum may be made directly from leucite by the use of sulphuric acid. The silica that remains may serve at once for the formation of valuable silicon compounds, such as sodium silicate. The treatment of leucite with hydrochloric acid involves greater difficulties in chemical engineering than the treatment with sulphuric acid, but potassium chloride with a purity of 98 to 99 per cent may be obtained, together with aluminum chloride. The aluminum chloride may be converted into hydrated oxide of aluminum and the hydrochloric acid driven off be used again in attacking fresh leucite.

The leucitic lavas that are being worked at the present time are at Fontanaradina, about 12 miles from the little port of Scauri. The rock, after a very shallow layer of soil is removed, can be quarried at once and by a simple telpherage system can be carried straight down over the intervening country to the wharf at Scauri by gravity.

The outcome of this experimental work with Italian lavas will be watched with interest because of its bearing on the possible future development of the somewhat similar lavas that constitute the Leucite Hills of Wyoming, which may be regarded as a potential source of potash and alumina compounds.

Poland.—Several deposits of potash salts are known to occur in Poland, but the only ones now worked are the deposits of sylvite and kainite near Kalusz, in former Austrian Poland. The exploitation is carried on by a private company in which the Government holds the majority of the stock.[19] Polish production of potash salts in 1922 amounted to 46,083 tons and in 1923 to 61,503 tons, a gain of 33 per cent.[20]

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[19] Am. Fertilizer, Feb. 9, 1924, p. 78.

[20] Commerce Repts., Apr. 7, 1924, p. 17; June 2, 1924, p. 590.

Russia.—From a recent interesting article by Minevitch and Malisoff [21] the following notes are abstracted:

The Russian potash industry has its origin in antiquity. At first the potash was derived from wood ashes. Later, as forests were depleted and wood was used for other purposes, the peasants began burning for potash all sorts of plants and weeds, but largely pigweeds, which possess a high potash content. Toward the end of the nineteenth century considerable attention was given to the utilization of sunflower stalks as a means of getting a steady and growing supply of potash. This source is to-day the basis of a considerable potash industry which is localized chiefly in the Kuban Province, in southeastern Russia. In 1917 the area under sunflower cultivation was 887,600 acres.

There are now 24 factories with a total yearly capacity of 26,500 tons of potash, requiring for its production about 80,000 tons of ash. The maximum capacity has never been obtained, however, the peak production having been made in 1912, when 20,000 tons of potash was produced. The unsettled conditions during and since the war have seriously affected the industry. The maximum production of the present factories is approximately 60 per cent of their pre-war capacity, and every effort is being made to work them up to this limit. According to statistical data for the current year, 540,000 acres of sunflowers was cultivated, from which the factories expect to collect about 27,500 tons of ash and to produce over 10,000 tons of potash.

The Kuban potash is known in foreign countries as Caucasian potash, and on account of its high quality it was able to compete with the German product. Aside from its cheaper cost, Caucasian potash is practically "sodium-free," which is considered another advantage. Russian exports average about 50 per cent of the production. Great Britain and Germany have hitherto bought large percentages of the Russian product.

It is stated [22] that Russian potash is again being offered to American consumers after several years of interruption. Calcined potassium carbonate, 80 to 85 per cent and 90 to 95 per cent, is being imported regularly.

Two sources of natural potassium nitrate in the Caucasus are described in a report by Consul John Randolph, Constantinople, prepared from information obtained in August and September, 1922. Both deposits are in the south range of the Caucasus Mountains, approximately 40 miles southeast of Tiflis. One is 6 miles south of the Dzegan railroad station. The salts contained in it have been proved by surface pits to be 80 feet deep. Analysis showed 3 per cent potassium nitrate. The other deposit, 15 miles from the Akstafa station, contains a large deposit which assays up to 10 per cent. Neither property is being operated.[23]

Spain.—According to a report published in the Boletín del Instituto geológico de España, the latest investigation of the potash deposits of Catalonia, Spain, showed that they extend over an area 42 kilometers long and 15 kilometers wide. Out of 23 borings made 19 have encountered the deposit, one at too great a depth for exploitation, the others at suitable depths. The best-known deposit lies at a depth of 200 to 800 meters. At present the contents are estimated at 2,000,000,000 tons of raw material. Exploitation is expected to begin shortly.[24]

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[21] Minevitch, J. R., and Malisoff, W. M., Extracting potash from Russian soil: Chem. and Met. Eng., Mar. 31, 1924.

[22] Oil, Paint, and Drug Reporter, Oct. 8, 1923, p. 71.

[23] Commerce Repts., July 2, 1923.

Sweden.—Government geologists have reported that Sweden has rich deposits of potash (mode of occurrence not stated) in the section southwest of Stockholm, and plans are going forward for the exploitation of a property estimated to contain 40,000,000 tons of potash minerals. Sweden has imported between 20,000 and 30,000 tons of potash annually during the last 10 years, and those interested in the new project hope to displace this potash with the domestic product.[25]

SUMMARY OF WORLD PRODUCTION

In the following table, compiled by Miss W. I. Whiteside, are listed the countries which in the last few years have produced potash, together with the figures for their production of crude salts, where these are available. The countries here listed differ to some extent from those given in the table of imports (pp. 171–172), because in that table some of the countries from which the imports came were not themselves producers but received their supply from other countries. In both tables, however, the predominance of Germany and Alsace as producers of potash is clearly shown.

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[24] Chem. and Met. Eng., vol. 30, p. 31, Jan. 7, 1924.

[25] Oil, Paint, and Drug Reporter, Dec. 3, 1923, p. 86.

World's production of potash minerals and content of K_2O, 1913, 1919–1923, in metric tons

Country and mineral [a]	1913		1919		1920		1921		1922		1923	
	Output	K_2O content	Output	K_2O content	Output	K_2O content	Output	K_2O content	Output	K_2O content	Output	K_2O content
Abyssinia, chloride of potash			934	467	1, 087	544	(b)	(b)	(b)	(b)	(b)	(b)
Australia:												
New South Wales, alunite	2, 271	(b)	2, 525	210	644	54	528	45	188	(b)	1, 014	(b)
South Australia, alunite			61		20		15		97	(b)		
Austria (Galicia), kainite and sylvinite	2, 344	(b)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Canada, natro-alunite							27	(b)	(b)	(b)	(b)	(b)
China [d]			648	(b)	542	(b)	608	(b)	493	(b)	(b)	(b)
France (Alsace), crude salts	(e)	(e)	591, 471	96, 546	1, 221, 925	194, 355	884, 140	144, 836	1, 227, 000	211, 675	[f]1,568,000	248, 528
Germany, crude salts	[e]11,956,528	(b)	7, 888, 152	(b)	11,390,166	(b)	9, 241, 179	1, 066, 849	13,012,320	1, 509, 850	(b)	(b)
India, British, nitrate of potash	14, 694	(b)	17, 832	7, 133	17, 145	6, 858	16, 149	6, 460	11, 673	(b)	(b)	(b)
other salts			84	12	51	7					(b)	(b)
Italy, alunite	5, 976	(b)	3, 507	375	3, 445	368	1, 171	125			135	(b)
leucite	1, 600	(b)	3, 468	(b)	8, 200	(b)	14, 805	(b)	18, 000	(b)	8, 720	(b)
Poland, kainite	(g)	(g)	2, 500	254	2, 300	230	182	18	2, 520	(b)	22, 128	(b)
sylvinite	(g)	(g)			7, 993	800	15, 329	1, 550	43, 563	(b)	39, 375	(b)
United States, crude salts	(h)	(h)	105, 808	29, 460	151, 348	43, 614	23, 119	9, 227	22, 839	10, 627	35, 406	18, 339

[a] Sources of information: Abyssinia, Imp. Mineral Resources Bur., London. Australia: New South Wales, Dept. Mines Ann. Rept.; South Australia, Dept. Mines Rev. Min. Operations; Imp. Mineral Resources Bur., London. Austria (Galicia), Data furnished by Polish Government through American legation, Warsaw. British India, India Geol. Survey Records; Imp. Mineral Resources Bur., London. Canada, Dominion Bur. Statistics. China, Maritime Customs, Foreign Trade of China. France, Statistique de l'industrie minérale en France et en Algérie; Direction des Mines, Ministère des Travaux Publics, Paris; Commerce Rpts., Mar. 24, 1924. Germany, Vierteljahrshefte zur Statistik; Glückauf, Apr. 15, 1922; consular report May 4, 1923. Italy, Rivista del servizio minerario; Imp. Mineral Resources Bur., London. Poland, Data furnished by Polish Government through American legation, Warsaw; Montanistische Rundschau, May 16, 1924; Imp. Mineral Resources Bur., London; legation of Poland, Washington.

[b] Data not available.

[c] Included under Poland.

[d] Exports.

[e] Production of Alsace in 1913 included under Germany.

[f] Reported as sylvinite, but believed to be crude potash salts.

[g] See Austria.

[h] Figures not available; production unimportant.

RECENT PATENTS

The following United States patents on the recovery of potash from various sources have been issued recently.

1453797, May 1, 1923, Frederick W. Huber. Cement flue dust, containing insoluble potassium compounds, either before or after leaching with water, is mixed with an amount of carbon—for example, coal dust—substantially equal in weight to the K_2O content of the flue dust, and lime in such proportions as to produce a mixture having a $CaO: SiO_2$ ratio of about 2:1, and preferably not less than 2:1, producing a mass which, by heating in a rotary kiln to a temperature between 600° and 1,000° C., becomes a product in which substantially the entire content of potassium compounds is rendered water-soluble and can be separated by leaching with water.

1457787, June 5, 1923, E. Moldenke. Finely divided alunite is treated with more than sufficient H_2SO_4 to convert the aluminum into sulphate, forming a base. The mixture is heated until it forms a brittle cake, and after the material is disintegrated it is introduced into a closed chamber and heated to cause evolution of fumes from the free acid present and render the values soluble in H_2O. The heating and hardening of the pasty mixture may be carried out on a sheet-metal flexible conveyor, the flexing of which serves to break the caked material and dislodge it from the conveyor. Clay and bauxite when treated with H_2SO_4 may be similarly handled.

1466352, August 28, 1923, C. E. Dolbear. NH_3 is added to brine such as Searles Lake or Deep Springs (Calif.) brines and the brine is kept in agitation to convert KCl into K_2SO_4 (by reaction with Na_2SO_4 first precipitated) and cause its precipitation.

1466353, August 28, 1923, C. E. Dolbear. Specifies a similar process except that Na_2SO_4 or other soluble sulphate is also added to the brine to precipitate K_2SO_4.

1468389, September 18, 1923, H. W. Morse. During the solar evaporation of Searles Lake brine the sulphate content is controlled by the use of a brine high in carbonate to start the pond operation and the gradual addition of raw brine (concentrated by preliminary evaporation at such a temperature as will prevent the separation of solid potassium salts) to the prepared brine. The operation is conducted so that the original high carbonate and low sulphate content are restored by evaporation before further additions of raw brine to the pond are made. This mode of operation facilitates obtaining a rich potassium salt solution.

1468390, September 18, 1923, H. W. Morse. Specifies treating Searles Lake brine by heating in the presence of solid NaCl to remove a portion of the sulphate content. The brine is then subjected to solar evaporation to produce a solution high in carbonate, and brine containing substantially the full potassium salt content of Searles Lake brine is then added after preliminary evaporation at such a temperature as will prevent separation of solid potassium salts. Evaporation is then continued to restore the high carbonate content of the brine.

1476873, December 11, 1923, G. B. Burnham. Searles Lake brine is allowed to undergo natural evaporation and cooling to effect successive fractional crystallization of different salts in layers which may be mechanically separated after deposition. The evaporation may be effected in deep ponds which are naturally cooled by atmospheric temperatures prevailing in the autumn.

1495498, May 27, 1924, Franz A. Rody, assignor to Metallurgical Co. of New York. Treatment of feldspar, leucite, and the like.

1496264, June 3, 1924, F. Giordani. A process of treating leucitic rocks to eliminate the silica, which passes into solution with acid treatment, consisting in neutralizing the liquid and allowing it to settle, so that the silica may be deposited.

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STONE

By G. F. Loughlin and A. T. Coons

PRODUCTION

The sales of stone in the United States in 1923 were the largest ever recorded. There was an increase of 29 per cent in quantity and of 31 per cent in value. All varieties of stone showed increases.

The tables of this report give quantities and values f. o. b. at quarries and mills as far as it is possible to obtain them. Stone quarried and used by the producer is considered as sold and is included in the figures given. This report does not, however, include the stone manufactured into abrasives (grindstones and pulpstones), glass sand, lime, and cement and reported in terms of finished product. These products are treated in the chapters on abrasives, sand and gravel, lime, and cement.

Stone sold or used by the producers in the United States, 1921–1923, by kinds

[Quantities approximate]

Year	Granite		Basalt and related rocks (trap rock)		Sandstone		Marble	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1921	4, 752, 180	$20, 592, 217	8, 524, 480	$11, 450, 899	2, 640, 460	$6, 425, 339	315, 400	$8, 580, 416
1922	5, 913, 120	21, 125, 869	10, 032, 900	12, 600, 611	3, 388, 130	7, 521, 044	427, 870	10, 534, 671
1923	7, 308, 930	30, 181, 796	10, 674, 470	13, 539, 648	4, 349, 270	9, 174, 706	562, 560	12, 863, 974
Percentage of increase in 1923	23. 6	42. 9	6. 4	7. 5	28. 4	22. 0	31. 5	22. 1

Year	Limestone		Miscellaneous [a]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1921	45, 621, 000	$57, 749, 594	1, 685, 220	$2, 163, 801	63, 538, 740	$106, 962, 266
1922	58, 928, 660	68, 397, 927	1, 520, 880	1, 886, 806	80, 211, 560	122, 066, 928
1923	76, 701, 360	89, 620, 007	3, 730, 870	4, 567, 110	103, 327, 460	159, 947, 241
Percentage of increase in 1923	30. 2	31. 0	145. 3	142. 1	28. 8	31. 0

[a] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, and such other stone as can not be properly classed in any of the main groups.

A fairly active demand prevailed throughout 1923 for stone of all kinds, and conditions at the quarries were better than in 1922. There were practically no strikes, and more cars were available for transportation, especially for crushed stone, than for several years. Labor was scarce and wages were high, yet, owing to improved methods and economies in operation, the cost of quarrying apparently remained about the same as in 1922. Prices varied, the average being higher for some kinds of stone and lower for others.

Stone sold or used by the producers in the United States, 1922 and 1923, by uses

Use	1922		1923	
	Quantity	Value	Quantity	Value
Building stone, cubic feet	24, 262, 250	$25, 749, 398	26, 515, 520	$32, 416, 717
Approximate equivalent in short tons	1, 929, 260		2, 067, 030	
Monumental stone, cubic feet	2, 974, 920	10, 567, 110	5, 108, 650	16, 213, 230
Approximate equivalent in short tons	248, 270		424, 310	
Paving blocks, number	31, 208, 800	2, 685, 234	45, 866, 480	4, 003, 490
Approximate equivalent in short tons	326, 290		462, 210	
Curbing, cubic feet	2, 867, 800	2, 137, 193	3, 227, 810	2, 936, 313
Approximate equivalent in short tons	236, 030		252, 300	
Flagging, cubic feet	650, 590	406, 731	607, 600	422, 059
Approximate equivalent in short tons	53, 580		43, 860	
Rubble, short tons	632, 100	947, 680	882, 010	1, 298, 050
Riprap, do	2, 048, 580	1, 768, 939	3, 185, 900	2, 989, 068
Crushed stone, do	49, 763, 740	54, 130, 177	62, 322, 710	67, 928, 651
Furnace flux (limestone and marble), long tons	16, 712, 500	14, 247, 024	22, 859, 330	20, 377, 138
Equivalent in short tons	18, 718, 000		25, 602, 450	
Refractory stone (ganister, mica schist, and dolomite), short tons	902, 170	1, 136, 236	1, 151, 900	1, 572, 794
Manufacturing industries (limestone and marble), short tons	3, 586, 250	3, 414, 073	4, 668, 470	4, 224, 230
Other uses [a], do	1, 767, 290	4, 877, 133	2, 264, 310	5, 565, 501
Total (quantities approximate, in short tons)	80, 211, 560	122, 066, 928	103, 327, 460	159, 947, 241

[a] Chiefly agricultural limestone. (See pp. 219, 222, and 223.)

All products shown in the preceding table, except stone for flagstone, increased in output in 1923, and stone for building and monumental work, curbing, crushed stone, refractory materials, and other uses exceeded the output of 1916, which had been the year of greatest output.

Building stone increased 9 per cent in 1923, after an increase of 43 per cent in 1922. The Indiana oolitic limestone used for building increased 22 per cent, Carthage (Mo.) building stone increased 20 per cent, and Ohio sandstone for architectural building increased 16 per cent, but there were decreases in output at less well known localities, and granite for architectural building stone did not fully recover from the effects of the strike among the quarrymen and stone cutters in 1922. Stone for both rough architectural work and dressed and cut stone increased, but stone for rough construction work, which includes rough blocks for foundations, face stone for walls, sea walls, retaining walls, bridge work, and similar stone, decreased in output in 1923. The average value per cubic foot of all building stone increased in 1923, although the average value of the rough architectural stone was slightly lower than in 1922.

Building stone sold or used by the producers in the United States, 1922 and 1923, by kinds

Kind	Rough				Dressed				Total	
	Constructional		Architectural		Sawed [a]		Cut [a]			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1922										
Granite	3, 746, 740	$550, 247	791, 610	$778, 366	[a] 112, 610	[a] $157, 560	[a] 407, 360	[a]$2, 760, 958	5, 058, 320	$4, 247, 131
Sandstone	1, 250, 600	157, 995	624, 500	353, 047	894, 790	953, 572	196, 510	482, 943	2, 966, 400	1, 947, 557
Limestone	2, 421, 800	271, 343	4, 352, 030	2, 577, 416	3, 880, 950	3, 713, 028	1, 962, 600	5, 857, 086	12, 617, 380	12, 418, 873
Marble			807, 420	1, 880, 861	620, 980	1, 626, 752	535, 360	3, 414, 770	1, 963, 760	6, 922, 383
Basalt	603, 070	71, 685							603, 070	71, 685
Miscellaneous	1, 053, 320	141, 769							1, 053, 320	141, 769
	9, 075, 530	1, 193, 039	6, 575, 560	5, 589, 690	5, 509, 330	6, 450, 912	3, 101, 830	12, 515, 757	24, 262, 250	25, 749, 398
Average value		$0. 13		$0. 85		$1. 17		$4. 03		$1. 06
1923										
Granite	4, 064, 460	768, 412	496, 940	451, 388	[a] 138, 980	[a] 307, 537	[a] 642, 370	[a] 3, 878, 025	5, 342, 750	5, 405, 362
Sandstone	1, 260, 510	201, 091	700, 240	375, 271	1, 096, 390	1, 156, 313	172, 310	397, 877	3, 229, 450	2, 130, 552
Limestone	2, 415, 300	238, 805	5, 031, 840	3, 184, 932	4, 925, 510	5, 676, 658	2, 267, 300	7, 120, 700	14, 639, 950	16, 221, 095
Marble			847, 380	1, 894, 033	711, 820	1, 476, 525	869, 480	5, 090, 735	2, 428, 680	8, 461, 293
Basalt	463, 380	57, 664							463, 380	57, 664
Miscellaneous	166, 100	45, 606	228, 000	70, 145			17, 210	25, 000	411, 310	140, 751
	8, 369, 750	1, 311, 578	7, 304, 400	5, 975, 769	6, 872, 700	8, 617, 033	3, 968, 670	16, 512, 337	26, 515, 520	32, 416, 717
Average value		$0. 16		$0. 82		$1. 25		$4. 16		$1. 22

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[a] For granite, sawed stone corresponds to dressed stone for construction work (walls, foundations, bridges) and cut stone to architectural stone for high-class buildings.

Stone sold or used by the producers in the United States, 1922 and 1923, by States

State	1922			1923		
	Number of active plants	Short tons (approximate)	Value	Number of active plants	Short tons (approximate)	Value
Alabama	21	[a] 863,910	[a] $828,435	28	[a] 1,299,160	[a] $1,401,693
Alaska	1	([b])	([b])	1	([b])	([b])
Arizona	13	287,600	120,206	16	285,540	211,787
Arkansas	12	300,970	417,729	18	517,050	673,197
California	112	5,521,690	6,879,002	144	7,623,470	8,905,584
Colorado	49	[a] 427,880	[a] 555,694	52	[a] 543,480	[a] 749,798
Connecticut	37	[a] 1,420,710	[a] 1,585,461	43	1,482,710	1,830,413
Delaware	2	([b])	([b])	3	84,440	132,157
District of Columbia	5	11,110	18,658	5	7,470	20,576
Florida	10	[a] 770,140	[a] 706,644	25	1,494,080	1,425,434
Georgia	35	444,590	3,349,293	29	563,910	3,942,294
Hawaii	7	257,040	500,892	8	354,480	738,137
Idaho	12	166,650	235,241	19	175,050	205,486
Illinois	74	6,781,310	6,473,566	71	9,111,830	8,358,556
Indiana	91	2,775,740	13,203,146	95	3,650,110	17,692,112
Iowa	38	620,810	657,161	33	[a] 603,550	[a] 698,207
Kansas	50	657,660	895,476	53	919,640	1,180,397
Kentucky	71	1,537,690	1,853,851	96	1,884,380	2,250,025
Louisiana	2	([b])	([b])	2	([b])	([b])
Maine	49	191,760	1,903,084	60	306,620	3,168,396
Maryland	36	997,260	1,435,923	39	1,244,010	2,054,125
Massachusetts	94	1,607,970	4,375,387	109	1,788,860	5,794,941
Michigan	32	[a] 7,741,110	[a] 4,910,786	31	[a] 10,715,910	[a] 6,303,136
Minnesota	59	656,970	3,163,716	63	701,210	4,281,687
Mississippi	1	([b])	([b])	2	([b])	([b])
Missouri	99	1,611,020	3,322,672	120	2,134,910	4,345,526
Montana	14	[a] 184,010	[a] 211,293	24	[a] 275,900	[a] 270,781
Nebraska	7	182,960	231,195	11	243,920	328,918
Nevada	2	([b])	([b])	4	84,240	89,585
New Hampshire	27	128,650	1,071,556	31	122,460	1,763,221
New Jersey	59	1,903,840	2,850,557	55	2,039,740	3,032,918
New Mexico	5	366,300	224,525	6	[a] 396,980	[a] 241,786
New York	155	[a] 6,463,770	[a] 8,744,124	146	7,043,880	9,610,324
North Carolina	29	[a] 948,810	[a] 2,483,851	37	[a] 1,397,460	[a] 3,579,351
Ohio	134	9,137,480	9,564,640	141	11,493,340	11,464,569
Oklahoma	28	1,156,950	1,327,370	34	[a] 1,265,900	[a] 1,427,920
Oregon	55	661,070	897,784	73	1,103,330	1,342,070
Pennsylvania	455	12,731,940	14,591,194	470	[a] 15,679,170	[a] 18,997,295
Porto Rico	11	90,480	202,710	12	86,600	192,661
Rhode Island	15	[a] 73,400	[a] 357,635	20	[a] 161,080	[a] 649,359
South Carolina	12	638,400	1,175,049	12	847,870	1,657,926
South Dakota	15	133,920	272,152	19	250,730	479,288
Tennessee	44	[a] 1,091,530	[a] 3,759,876	47	1,454,180	4,341,393
Texas	29	1,335,660	1,314,203	36	2,200,690	2,102,281
Utah	16	411,590	380,246	15	784,750	608,991
Vermont	48	190,410	5,331,970	55	342,520	8,661,906
Virginia	57	1,626,740	1,801,778	64	2,216,140	2,482,937
Washington	31	[a] 647,160	[a] 887,175	43	678,880	953,831
West Virginia	33	2,163,470	2,134,944	32	2,550,710	2,660,415
Wisconsin	102	[a] 1,800,230	[a] 3,310,387	131	2,488,180	4,590,528
Wyoming	9	104,390	205,798	16	[a] 186,150	[a] 281,595
Undistributed		386,810	1,342,893		440,790	1,771,728
	2,404	80,211,560	122,066,928	2,699	103,327,460	159,947,241

[a] To avoid disclosing confidential information, certain State totals are slightly incomplete, the figures not included being combined under "Undistributed."

[b] Included under "Undistributed."

EXPORTS AND IMPORTS[1]

Stone exported from the United States, 1919–1923

Kind	1919	1920	1921	1922	1923
Marble and stone, unmanufactured	$770,392	$774,442	$576,905	$681,658	$625,442
All other, manufactured	1,508,997	2,158,764	1,697,570	903,102	783,195
	2,279,389	2,933,206	2,274,475	1,584,760	1,408,637

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[1] The tables of exports and imports were compiled by J. A. Dorsey, of the United States Geological Survey, from the records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Stone exported from the United States in 1923

Country	Marble				Other building or monumental stone		Other manufactures of stone (including paving blocks and curbing)		Total value
	Blocks (rough or dressed)		Manufactures						
	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Short tons	Value	
North America:									
Canada	43,494	$169,824	201	$54,618	389,929	$390,480	18,577	$374,631	$989,553
Central America:									
British Honduras	--------	--------	2	437	--------	--------	3	739	1,176
Costa Rica	--------	--------	--------	--------	--------	--------	2	492	492
Guatemala	--------	--------	--------	--------	--------	--------	28	623	623
Honduras	--------	--------	17	5,006	--------	--------	30	4,204	9,210
Nicaragua	--------	--------	(a)	25	--------	--------	6	1,934	1,959
Panama	30	106	1	395	--------	--------	130	9,801	10,302
Salvador	--------	--------	--------	--------	--------	--------	5	745	745
Mexico	728	3,104	6	2,601	(b)	(b)	137	20,632	[b] 28,049
Miquelon and St. Pierre	--------	--------	--------	--------	--------	--------	(a)	12	12
Newfoundland and Labrador	1,311	7,233	(a)	19	5	92	20	2,420	9,764
West Indies:									
British—									
Barbados	6	71	1	367	--------	--------	--------	--------	438
Bermuda	--------	--------	5	923	--------	--------	3	905	1,828
Jamaica	--------	--------	(a)	81	--------	--------	53	8,796	8,877
Trinidad and Tobago	54	339	--------	--------	--------	--------	(a)	161	500
Other	9	125	9	3,206	16	400	8	1,706	5,437
Cuba	4,773	16,307	39	6,415	--------	--------	91	15,969	38,691
Dominican Republic	2	18	3	192	--------	--------	6	1,766	1,976
Dutch West Indies	--------	--------	(a)	16	--------	--------	(a)	78	94
Haiti	16	97	1	148	--------	--------	2	454	699
Virgin Islands of the United States	1	34	3	733	--------	--------	1	378	1,145
	50,424	197,258	288	75,182	[b]389,950	[b]390,972	19,102	446,446	[b]1,111,570
South America:									
Argentina	--------	--------	--------	--------	16,463	32,615	182	32,077	64,692
Brazil	--------	--------	(a)	97	--------	--------	3	906	1,003
Chile	--------	--------	--------	--------	--------	--------	5	3,644	3,644
Colombia	42	114	10	237	--------	--------	16	6,268	6,619
Ecuador	--------	--------	1	703	--------	--------	3	614	1,317
Peru	--------	--------	(a)	44	140	2,000	--------	--------	2,044
Venezuela	--------	--------	--------	--------	--------	--------	4	869	869
Other South America	--------	--------	--------	--------	--------	--------	51	11,145	11,145
	42	114	11	1,081	16,603	34,615	264	55,523	91,333
Europe:									
France	--------	--------	(a)	3,500	38	421	107	4,117	8,038
Germany	--------	--------	(a)	50	--------	--------	--------	--------	50
Italy	--------	--------	(a)	200	--------	--------	1	350	550
Netherlands	--------	--------	--------	--------	--------	--------	73	9,947	9,947
United Kingdom—									
England	--------	--------	21	20,212	--------	--------	97	5,582	25,794
Scotland	--------	--------	--------	--------	--------	--------	(a)	30	30
Other Europe	--------	--------	3	1,191	--------	--------	65	5,642	6,833
	--------	--------	24	25,153	38	421	343	25,668	51,242
Asia:									
China	--------	--------	1	476	--------	--------	5	917	1,393
India (British)	--------	--------	--------	--------	--------	--------	314	42,464	42,464
Japan	--------	--------	8	6,851	--------	--------	341	43,972	50,823
Philippine Islands	--------	--------	(a)	50	--------	--------	35	4,723	4,773
Other Asia	--------	--------	2	2,151	31	350	16	2,416	4,917
	--------	--------	11	9,528	31	350	711	94,492	104,370
Africa:									
British South Africa	--------	--------	(a)	182	--------	--------	55	10,053	10,235
Other Africa	--------	--------	1	460	--------	--------	6	1,727	2,187
	--------	--------	1	642	--------	--------	61	11,780	12,422
Oceania:									
Australia	--------	--------	8	1,142	--------	--------	99	19,705	20,847
New Zealand	--------	--------	1	558	--------	--------	82	15,267	15,825
Other Oceania	--------	--------	--------	--------	--------	--------	6	1,028	1,028
	--------	--------	9	1,700	--------	--------	187	36,000	37,700
Grand total	50,466	197,372	344	113,286	[b]406,622	[b]426,358	20,668	669,909	[b]1,408,637

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[a] Less than 1 ton.

[b] From "other building or monumental stone" is excluded by the Geological Survey 167,652 cubic feet of stone, valued at $1,712, shipped from Andrade, Calif., into Mexico for the protection of levees and other riprap work. The value of this material is, however, included in the total value for Mexico and in the grand total value.

Stone imported for consumption in the United States, 1922 and 1923

Kind	1922		1923	
	Quantity	Value	Quantity	Value
Marble:				
In blocks, rough, etc.......cubic feet..	[a] 546,400	[a]$1,137,154	[a] 699,412	[a]$1,513,192
Sawed.......do....	42	112	134	390
Slabs or paving tiles.......square feet..	[a] 294,549	[a] 84,471	[a] 129,244	[a] 54,618
All other manufactures	....	[a] 196,754	....	[a] 283,109
Mosaic cubes of marble or onyx:				
Loose	....	25,259	....	21,647
Attached to paper	....	665	....	....
	....	[a] 1,444,415	....	[a] 1,872,956
Onyx:				
In blocks, rough, etc.......cubic feet..	[a] 2,134	[a] 12,357	([a])	([a])
Slabs or paving tiles.......square feet..	[a] 2,019	[a] 616	([a])	([a])
All other manufactures	....	[a] 4,906	....	([a])
	....	[a] 17,879	....	([a])
Granite:				
Dressed	....	183,776	....	270,432
Rough.......cubic feet.	72,061	106,121	176,096	221,796
	....	289,897	....	492,228
Stone (other):				
Dressed	....	18,124	....	17,305
Rough (monumental or building stone)..cubic feet..	63,944	68,416	80,770	74,377
Rough (other)	....	57,181	....	182,083
	....	143,721	....	273,765
Grand total	....	1,895,912	....	2,638,949

[a] Onyx not separately classified after new tariff went into effect (Sept. 22, 1922), but included under "Marble."

General imports of marble and onyx, rough and manufactured, into the United States, 1922 and 1923

Country	1922				1923			
	Rough marble, breccia, and onyx		Manufactured	Total value	Rough marble, breccia, and onyx		Manufactured	Total value
	Cubic feet	Value			Cubic feet	Value		
Canada	119	$486	$6,833	$7,319	8	$35	$717	$752
Cuba	32	78	442	520	....	....	....	....
Guatemala	1,045	6,612	....	6,612	....	....	....	....
Mexico	6,550	37,020	5	37,025	5,349	24,933	....	24,933
Total North America	7,746	44,196	7,280	51,476	5,357	24,968	717	25,685
Belgium	65,169	146,292	5,790	152,082	42,486	85,718	16,951	102,669
France	17,905	40,302	19,514	59,816	21,150	49,323	27,423	76,746
Germany	1,461	1,057	16,207	17,264	2,243	5,540	56,500	62,040
Greece	4,036	18,010	....	18,010	8,619	35,220	....	35,220
Italy	455,335	918,856	250,269	1,169,125	616,111	1,299,710	231,214	1,530,924
Netherlands	....	....	....	....	....	....	2,769	2,769
Spain	....	....	1,505	1,505	....	....	34	34
England	....	....	6,228	6,228	279	749	6,296	7,045
Other Europe[a]	....	....	3,535	3,535	893	2,322	11,821	14,143
Total Europe	543,906	1,124,517	303,048	1,427,565	691,781	1,478,582	353,008	1,831,590
China	....	....	1,007	1,007	....	....	2,925	2,925
Japan	74	130	94	224	....	....	524	524
Other countries[b]	133	455	1,399	1,854	861	3,202	3,144	6,346
	207	585	2,500	3,085	861	3,202	6,593	9,795
Grand total	551,859	1,169,298	312,828	1,482,126	697,999	1,506,752	360,318	1,867,070

[a] 1922: Austria, Czechoslovakia, Denmark, Netherlands, Poland and Danzig, Scotland, Sweden, and Switzerland. 1923: Austria, Czechoslovakia, Denmark, Gibraltar, Norway, Scotland, Sweden, Switzerland, and Turkey in Europe.

[b] 1922: Algeria and Tunis, Australia, Egypt, Hongkong, India (British), Palestine and Syria, and Venezuela. 1923: Ceylon, Hongkong, India (British), Palestine and Syria, and Uruguay.

Value of building and monumental stone (exclusive of marble, onyx, and breccia) and other classes of stone imported into the United States in 1923

[General imports]

Country	Building and monumental stone	Other stone	Total
North America:			
Canada	$53,129	$167,724	$220,853
Cuba	1	225	226
Mexico	10		10
	53,140	167,949	221,089
Europe:			
Austria	28		28
Belgium	1,569	595	2,164
Czechoslovakia	10,280		10,280
Denmark	2,301	1,088	3,389
Finland	12,967		12,967
France	50,570	14	50,584
Germany	162,986	11,397	174,383
Italy	97,283	2,017	99,300
Netherlands	190	13,464	13,654
Norway	2,706		2,706
Sweden	118,695		118,695
United Kingdom—			
England	11,683	20,218	31,901
Scotland	74,232		74,232
	545,490	48,793	594,283
Other countries [a]	2,239	18	2,257
Total imports	600,869	216,760	817,629

[a] Algeria and Tunis, China, Chosen, Hongkong, India (British), and Japan.

PRODUCTION BY KINDS AND STATES

GRANITE

Granite as a whole showed an increase of about 24 per cent in quantity and 43 per cent in value in 1923 as compared with 1922. With the exception of granite for rubble and unspecified purposes ("other stone") all the products increased in both quantity and value. The output of granite for monumental work, which during 1921 and 1922 suffered severely from labor troubles and lack of demand, increased about 90 per cent in quantity in 1923. Granite for building stone did not recover so quickly from the labor troubles that retarded the output in 1922, but there was an increase in all grades of granite for this purpose except that for rough architectural work. The report on stone in Mineral Resources for 1922 gave the names of the principal producers of granite for monumental and structural stone, and the output of several of the more prominent districts. The only tables of production repeated here are those for Quincy, Mass., and Barre, Vt., as the other districts are adequately represented in the general table on pages 213–214.

Granite for paving blocks and granite for curbing, which were included among the products affected by the strike of granite cutters in 1922, increased in output 60 and 49 per cent, respectively, in 1923. Granite for crushed stone increased 22 per cent.

Granite sold or used by the producers in the United States, 1922 and 1923, by uses

Use	1922		1923	
	Quantity	Value	Quantity	Value
Building stone (rough and dressed) cubic feet	5, 058, 320	$4, 247, 131	5, 342, 750	$5, 405, 362
Approximate equivalent in short tons	419, 500		442, 740	
Monumental stone cubic feet	2, 085, 740	7, 429, 332	3, 955, 900	12, 481, 457
Approximate equivalent in short tons	172, 760		326, 550	
Paving number of blocks	25, 693, 300	2, 232, 628	41, 016, 640	3, 578, 182
Approximate equivalent in short tons	269, 550		414, 930	
Curbing linear feet	1, 407, 760	900, 101	2, 104, 150	1, 436, 212
Approximate equivalent in short tons	87, 340		108, 860	
Rubble short tons	174, 740	221, 264	167, 980	183, 589
Riprap do	652, 210	480, 826	808, 390	711, 490
Crushed stone do	4, 096, 910	5, 415, 076	5, 009, 280	6, 230, 109
Other uses do	40, 110	199, 511	30, 200	155, 395
Total (quantities approximate, in short tons)	5, 913, 120	21, 125, 869	7, 308, 930	30, 181, 796

Granite sold or used by the producers in the United States, 1922 and 1923, by States

[Quantities approximate]

State	1922		1923	
	Short tons	Value	Short tons	Value
Arizona	213, 770	$50, 585	139, 620	$56, 813
Arkansas	19, 140	23, 563	22, 270	20, 869
California	1, 885, 600	2, 878, 708	2, 366, 500	2, 962, 406
Colorado	1, 880	132, 730	47, 090	190, 356
Connecticut	17, 830	211, 301	23, 650	285, 004
Delaware	(a)	(a)	84, 440	132, 157
District of Columbia	11, 110	18, 658	7, 470	20, 576
Georgia	221, 260	1, 057, 823	332, 300	1, 462, 297
Idaho	(a)	(a)	(a)	(a)
Maine	146, 450	1, 803, 473	258, 580	3, 059, 608
Maryland	195, 200	383, 868	200, 930	426, 998
Massachusetts	464, 500	2, 519, 832	552, 450	3, 687, 169
Minnesota	111, 680	2, 085, 880	68, 540	2, 979, 014
Missouri	12, 970	85, 093	9, 260	83, 804
Montana	910	57, 393	40, 600	59, 571
New Hampshire	116, 960	1, 048, 339	114, 050	1, 731, 295
New Jersey	(a)	(a)	(a)	(a)
New York	117, 800	370, 471	61, 220	204, 578
North Carolina	835, 950	2, 325, 940	1, 265, 540	3, 376, 778
Oklahoma	20, 520	121, 478	6, 340	96, 983
Oregon	(a)	(a)		
Pennsylvania	231, 450	577, 443	189, 420	599, 578
Rhode Island	36, 730	284, 122	83, 750	507, 139
South Carolina	638, 400	1, 175, 049	847, 870	1, 657, 926
South Dakota	10, 800	84, 954	11, 310	121, 400
Texas	9, 430	110, 453	22, 610	158, 563
Utah	(a)	(a)	430	8, 300
Vermont	55, 710	1, 679, 986	132, 860	4, 000, 440
Virginia	162, 420	178, 889	121, 390	157, 987
Washington	72, 470	184, 435	56, 410	162, 271
Wisconsin	157, 050	1, 414, 430	221, 580	1, 935, 592
Undistributed	145, 130	260, 973	20, 450	36, 324
	5, 913, 120	21, 125, 869	7, 308, 930	30, 181, 796

[a] Included under "Undistributed."

Granite sold or used by the producers in the United States in 1923, by States and uses

State	Number of active plants	Building						Monumental				Paving blocks	
		Rough construction		Rough architectural		Dressed architectural		Rough		Dressed			
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Number	Value
Arizona	5									(a)	(a)		
Arkansas	4												
California	34	2,240	$4,480	102,150	$102,750	155,260	$539,868	51,280	$113,373	55,430	$443,686		
Colorado	16							(b)	(b)	[b]30,510	[b]133,206		
Connecticut	17	3,820	7,624	(b)	(b)	[b]9,370	[b]69,926	26,730	95,909	7,260	67,217	115,690	$10,249
Delaware	3	(a)	(a)	(a)	(a)			(a)	(a)	(a)	(a)		
District of Columbia	5	7,410	20,326										
Georgia	20	(a)	(a)	(b)	(b)	[b]75,260	[b]214,490	122,130	182,793	32,090	190,051	4,399,420	271,594
Idaho	1												
Maine	56	(a)	(a)	87,300	78,782	170,510	1,150,257	131,480	200,483	23,460	87,335	13,195,850	1,213,009
Maryland	11	107,190	229,571	(a)	(a)			[c]17,270	[c]21,411	(c)	(c)	(a)	(a)
Massachusetts	62	39,480	52,875	34,160	37,585	155,830	731,209	435,390	726,878	45,650	352,541	6,503,630	723,456
Minnesota	32			(b)	(b)	[b]83,850	[b]538,737	118,740	295,115	282,880	2,047,954	670,770	60,866
Missouri	4							(a)	(a)			433,000	40,640
Montana	12					3,890	19,430	2,830	3,712	1,660	20,090		
New Hampshire	28	4,380	5,714	39,990	36,399	99,630	534,324	105,300	195,349	60,240	441,799	5,055,210	356,779
New Jersey	1												
New York	12	4,600	6,272	11,700	11,847	2,180	16,846	11,370	26,775	1,240	9,569	(a)	(a)
North Carolina	31	1,730	3,040	62,010	55,546	34,330	184,825	(a)	(a)	(a)	(a)	3,844,310	293,286
Oklahoma	7							5,200	10,490	5,300	83,092		
Pennsylvania	27	133,730	283,080	(a)	(a)	(a)	(a)	23,010	44,362	16,400	138,953	(a)	(a)
Rhode Island	14	430	580	2,140	1,757			120,200	329,647			93,000	7,285
South Carolina	12	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)			417,500	30,945
South Dakota	4							(a)	(a)	(a)	(a)		
Texas	9			37,000	25,109			[c]46,510	[c]116,477	(c)	(c)		
Utah	1					2,590	3,240			2,530	5,060		
Vermont	36			(a)	(a)	(a)	(a)	[c]1,492,160	[c]3,810,525	(c)	(c)	(a)	(a)
Virginia	7	(a)	(a)										
Washington	6					(a)	(a)	(b)	(b)	[b]9,250	[b]52,480		
Wisconsin	23	(a)	(a)					22,240	42,160	140,650	1,126,328	5,326,400	495,954
Undistributed		32,140	154,850	78,950	52,517	30,190	231,506	426,870	531,894	82,640	534,743	961,860	74,119
	500	337,150	768,412	496,940	451,388	781,350	4,185,562	3,155,580	6,726,423	800,320	5,755,034	41,016,640	3,578,182
Average value			$2.28		$0.91		$5.36		$2.13		$7.19		[d]$87.24

[a] Included under "Undistributed."

[b] Rough stone included under dressed stone.

[c] Dressed stone included under rough stone.

[d] Per M.

Granite sold or used by the producers in the United States in 1923, by States and uses—Continued

State	Number of active plants	Curbing		Rubble		Riprap		Crushed stone				Other uses		Total	
								Concrete and road metal		Railroad ballast					
		Linear feet	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Arizona	5					(a)	(a)	(a)	(a)					139,620	$56,813
Arkansas	4			(a)	(a)	(a)	(a)	8,070	$9,156					22,270	20,869
California	34	1,750	$3,474			366,430	$323,109	1,651,010	1,214,521	312,250	$211,345	4,600	$5,800	2,366,500	2,962,406
Colorado	16					(a)	(a)	43,800	56,450			(a)	(a)	47,090	190,356
Connecticut	17	13,580	12,579					14,500	21,500					23,650	285,004
Delaware	3	(a)	(a)	(a)	(a)			(a)	(a)					84,440	132,187
District of Columbia	5	1,150	250											7,470	20,576
Georgia	20	741,360	346,639	78,120	$64,918	12,200	15,932	141,440	170,222	4,000	3,000	(a)	(a)	332,300	1,462,297
Idaho	1					(a)	(a)	(a)	(a)					(a)	(a)
Maine	56	107,790	78,236			10,870	10,208	55,570	106,142			(a)	(a)	258,580	3,059,608
Maryland	11			2,990	6,385	(a)	(a)	62,980	91,473	(a)	(a)			200,930	426,998
Massachusetts	62	359,610	399,903	29,180	48,822	33,350	32,856	301,100	571,981	5,480	8,223	30	840	552,450	3,687,169
Minnesota	32					(a)	(a)	20,290	34,466			(a)	(a)	68,540	2,979,014
Missouri	4					2,630	2,393	(a)	(a)					9,260	83,804
Montana	12	(a)	(a)	(a)	(a)	8,510	6,792					(a)	(a)	40,600	59,571
New Hampshire	28	190,680	131,796	1,580	936	5,770	5,379	13,120	21,407			420	1,413	114,050	1,731,295
New Jersey	1							(a)	(a)					(a)	(a)
New York	12	(a)	(a)	(a)	(a)			13,700	17,834	25,570	20,811	(a)	(a)	61,220	204,578
North Carolina	31	624,040	392,390	9,440	29,799	(a)	(a)	991,010	1,620,337	109,000	115,000	12,180	90,267	1,265,540	3,376,778
Oklahoma	7	(a)	(a)			(a)	(a)							6,340	96,983
Pennsylvania	27	10,500	10,114	8,590	14,543	(a)	(a)	30,710	58,737	(a)	(a)			189,420	599,578
Rhode Island	14	(a)	(a)	1,390	3,147	(a)	(a)	67,640	156,869			2,680	2,000	83,750	507,139
South Carolina	12	(a)	(a)	(a)	(a)	101,480	135,464	595,600	976,300	112,000	124,896			847,870	1,657,926
South Dakota	4							(a)	(a)					11,310	121,400
Texas	9	(a)	(a)			15,730	15,727					(a)	(a)	22,610	158,563
Utah	1													430	8,300
Vermont	36					(a)	(a)	5,790	8,780					132,860	4,000,440
Virginia	7					(a)	(a)	93,290	123,167	20,400	17,520			121,390	157,987
Washington	6					55,130	59,525					(a)	(a)	56,410	162,271
Wisconsin	23	41,420	46,661	(a)	(a)	(a)	(a)	146,750	213,541			(a)	(a)	221,580	1,935,592
Undistributed		12,270	14,170	36,690	15,039	196,290	104,105	144,040	217,581	20,170	38,850	10,290	55,075	20,450	36,324
	500	2,104,150	1,436,212	167,980	183,589	808,390	711,490	4,400,410	5,690,464	608,870	539,645	[b]30,200	[b]155,395	7,308,930	30,181,796
Average value			$0.68		$1.09		$0.88		$1.29		$0.89		$5.15		$4.13

[a] Included under "Undistributed."

[b] Includes 11,260 tons of durax paving blocks, valued at $95,450, made in Massachusetts, New Hampshire, North Carolina, and Wisconsin.

Monumental granite sold at Quincy, Mass., 1919–1923 [a]

Year	Number of active plants	Short tons (approximate)	Value
1919	8	32, 000	$614, 005
1920	8	27, 000	674, 233
1921	6	14, 000	311, 178
1922	6	16, 000	341, 601
1923	6	27, 150	596, 709

[a] A small amount of stone from these quarries is also sold for rough construction, riprap, and crushed stone.

Monumental granite sold by the quarrymen in the Barre district, Vt., 1919–1923

Year	Cubic feet	Value	Year	Cubic feet	Value
1919	1, 376, 000	$3, 623, 055	1922	453, 000	$1, 395, 911
1920	1, 147, 800	3, 957, 881	1923	1, 208, 010	3, 300, 805
1921	686, 947	2, 417, 024			

Through the kindness of Mr. R. E. Mitchell, secretary of the Barre Granite Manufacturers Association, the following figures covering the entire granite industry at Barre are given to supplement the figures of production reported to the Geological Survey by the quarrymen:

Estimated output of monumental granite in Barre district, 1920–1923

	1920	1921	1922	1923
Total quarry output, rough stock ..... cubic feet	1, 178, 442	474, 000	620, 626	1, 254, 714
Shipped out of Barre district in rough ..... do	176, 766	71, 100	172, 884	251, 996
Manufactured in Barre district ..... do	1, 001, 676	402, 900	447, 742	1, 002, 718
Light stock consumed in district ..... do	626, 048	251, 813	279, 841	626, 701
Dark stock consumed in district ..... do	375, 628	151, 087	167, 901	376, 017
Number of cutters in district	1, 400	1, 100	1, 000	1, 250
Average daily wage	$7. 20	$8. 00	$8. 00	$8. 00
Average number of days worked	230	160	70	270
Total pay roll for year	$2, 318, 400	$1, 408, 000	$560, 000	$2, 700, 000
Estimated overhead	1, 159, 200	704, 000	280, 000	1, 350, 000
Estimated value of light stock	2, 253, 773	906, 527	940, 265	2, 256, 123
Estimated value of dark stock	1, 540, 075	619, 457	805, 924	1, 940, 246
Estimated polishing cost	600, 000	300, 000	311, 500	600, 000
Output from saws	200, 000	100, 000	160, 000	250, 000
Total value of granite	8, 071, 448	4, 037, 984	3, 057, 689	9, 096, 369

BASALT AND RELATED ROCKS (TRAP ROCK)

There was an increase of 6 per cent in the output of basalt and related rocks in 1923. Crushed stone, which is the principal product, increased 7 per cent. There was also an increase in the stone for paving blocks, riprap, and "other" uses, but stone for building purposes and rubble decreased. Under "other" is reported 85,200 short tons of "roofing granules," valued at $628,297, made from altered diabase (greenstone). Besides these "roofing granules" others of slate and slate "flour," amounting to 462,260 tons, valued at $3,268,554, were sold in 1923.

Basalt and related rocks (trap rock) sold or used by the producers in the United States, 1922 and 1923, by uses

Use	1922		1923	
	Quantity	Value	Quantity	Value
Building stone ... cubic feet	603,070	$71,685	463,380	$57,664
Approximate equivalent in short tons	54,680		39,530	
Paving blocks ... number	144,240	7,065	241,120	8,342
Approximate equivalent in short tons	1,600		2,580	
Rubble ... short tons	59,600	119,793	44,460	188,759
Riprap ... do	237,810	228,448	255,020	182,958
Crushed stone ... do	9,603,850	11,654,268	10,247,680	12,473,628
Other (principally roofing granules) ... do	75,360	519,352	85,200	628,297
Total (quantities approximate, in short tons)	10,032,900	12,600,611	10,674,470	13,539,648

Basalt and related rocks (trap rock) sold or used by the producers in the United States, 1922–23, by States

[Quantities approximate]

State	1922		1923	
	Short tons	Value	Short tons	Value
California	2,134,200	$2,127,230	1,820,150	$1,798,640
Connecticut	1,396,660	1,351,423	1,441,840	1,517,286
Hawaii	257,040	500,892	354,480	738,137
Idaho	126,120	160,400	114,410	109,366
Maryland	341,270	520,778	407,040	708,258
Massachusetts	828,540	928,731	934,160	1,134,044
Michigan	94,560	376,788	109,810	420,524
Minnesota	214,920	334,821	176,710	257,334
Montana			(a)	(a)
New Jersey	1,581,740	2,412,109	1,596,170	2,422,338
New Mexico	171,000	103,585	180,800	119,123
New York	101,510	151,977	(a)	(a)
Oregon	657,050	866,988	915,350	1,101,177
Pennsylvania	1,394,770	1,899,287	1,384,500	1,940,670
Texas	(a)	(a)	(a)	(a)
Virginia	(a)	(a)	18,680	28,745
Washington	534,310	607,930	553,280	521,027
Wisconsin	90,000	112,500	148,000	228,000
Undistributed	109,210	145,172	519,090	494,979
	10,032,900	12,600,611	10,674,470	13,539,648

(a) Included under "Undistributed."

Basalt and related rocks (trap rock) sold or used by the producers in the United States in 1923, by States and uses

State	Number of active plants	Building, rough construction		Rubble and riprap		Crushed stone for concrete and road metal	
		Short tons	Value	Short tons	Value	Short tons	Value
California	30	(a)	(a)	9,520	$10,709	1,604,190	$1,563,356
Connecticut	21	14,420	$10,048			1,404,380	1,485,686
Hawaii	8			44,750	190,000	309,010	544,637
Idaho	8					114,410	109,366
Maryland	9	(a)	(a)			213,610	423,777
Massachusetts	21	600	1,000			916,920	1,115,391
Michigan	6					(a)	(a)
Minnesota	5	(a)	(a)	420	342	127,310	142,968
Montana	1			(a)	(a)		
New Jersey	36	900	750	(a)	(a)	1,447,540	2,248,750
New Mexico	1						
New York	3			(a)	(a)	(a)	(a)
Oregon	66			63,380	68,091	689,990	934,404
Pennsylvania	29	11,990	29,393	10,560	5,307	984,010	1,262,893
Texas	2					(a)	(a)
Virginia	1					18,680	28,745
Washington	30			112,580	57,399	368,370	448,872
Wisconsin	1					148,000	228,000
Undistributed		11,620	16,473	58,270	39,869	204,180	256,356
	278	39,530	57,664	299,480	371,717	8,550,600	10,793,201
Average value			$1.46		$1.24		$1.26

(a) Included under "Undistributed."

Basalt and related rocks (trap rock) sold or used by the producers in the United States in 1923, by States and uses—Continued

State	Number of active plants	Crushed stone for railroad ballast		Other uses		Total	
		Short tons	Value	Short tons	Value	Short tons	Value
California	30	204,390	$202,470	(a)	(a)	1,820,150	$1,798,640
Connecticut	21	(a)	(a)	(a)	(a)	1,441,840	1,517,286
Hawaii	8			(a)	(a)	354,480	738,137
Idaho	8					114,410	109,366
Maryland	9	(a)	(a)			407,040	708,258
Massachusetts	21	16,640	17,653			934,160	1,134,044
Michigan	6			(a)	(a)	109,810	420,524
Minnesota	5	(a)	(a)	8,900	$62,300	176,710	257,334
Montana	1					(a)	(a)
New Jersey	36	145,870	170,207	(a)	(a)	1,596,170	2,422,338
New Mexico	1	180,800	119,123			180,800	119,123
New York	3	(a)	(a)			(a)	(a)
Oregon	66	161,980	98,682			915,350	1,101,177
Pennsylvania	29	348,310	434,124	29,630	208,953	1,384,500	1,940,670
Texas	2	(a)	(a)			(a)	(a)
Virginia	1					18,680	28,745
Washington	30	72,330	14,756			553,280	521,027
Wisconsin	1					148,000	228,000
Undistributed		566,760	623,412	49,250	365,386	519,090	494,979
	278	1,697,080	1,680,427	[b] 87,780	[b] 636,639	10,674,470	13,539,648
Average value			$0.99		$7.25		$1.27

[a] Included under "Undistributed."

[b] Composed of 85,200 short tons of roofing granules, valued at $628,297, from California, Michigan, Minnesota, and Pennsylvania; and 241,120 paving blocks, valued at $8,342 ($34.60 per M), from Connecticut, Hawaii, and New Jersey.

MARBLE

SUMMARY

There was an increase of over 31 per cent in the quantity and 22 per cent in the value of the total output of marble in 1923. The quantity of building stone increased 24 per cent and the monumental stone 30 per cent.

The average value per cubic foot for all classes of marble building stone except that sold for dressed interior work decreased. There was also a decrease in the average value of monumental stone. The amount of marble sold as by-products from the quarries represents about 46 per cent of the total output. This is sold as crushed stone, fluxing stone, marble "flour," terrazzo, mosaic, stucco, etc.

Marble sold by the producers in the United States, 1922–1923, by uses

Use	1922			1923		
	Quantity	Value		Quantity	Value	
		Total	Average		Total	Average
Building stone:						
Rough—						
Exterior ..... cubic feet	174, 550	$393, 687	$2. 26	230, 460	$456, 022	$1. 98
Interior ..... do	632, 870	1, 487, 174	2. 35	616, 920	1, 438, 011	2. 33
Dressed—						
Exterior ..... do	488, 950	1, 728, 206	3. 53	679, 440	1, 992, 346	2. 93
Interior ..... do	667, 390	3, 313, 316	4. 96	901, 860	4, 574, 914	5. 07
Total exterior ..... do	663, 500	2, 121, 893	3. 20	909, 900	2, 448, 368	2. 69
Total interior ..... do	1, 300, 260	4, 800, 490	3. 69	1, 518, 780	6, 012, 925	3. 96
Total building stone ..... do	[a] 1,963,760	[a] 6,922,383	3. 53	[a] 2,428,680	[a] 8,461,293	3. 48
Monumental stone:						
Rough ..... do	341, 740	749, 738	2. 19	147, 690	170, 402	1. 15
Dressed ..... do	547, 440	2, 388, 040	4. 36	1, 005, 060	3, 561, 371	3. 54
Total monumental stone ..... do	[a] 889,180	[a] 3,137,778	3. 53	[a] 1, 152, 750	[a] 3, 731, 773	3. 24
Total building and monumental						
{ ..... cubic feet	2, 852, 940	10, 060, 161	3. 53	3, 581, 430	12, 193, 066	3. 40
{ approximate short tons	242, 670	----------	--------	303, 760	----------	--------
Marble for other uses (by-products) ..... short tons	185, 200	474, 510	2. 56	258, 800	670, 908	2. 59
Total marble ..... approximate short tons	427, 870	10, 534, 671	--------	562, 560	12, 863, 974	--------

[a] Building-stone figures may be somewhat less than given and monumental stone somewhat more, as some of the Tennessee producers were unable to divide their product according to use.

Marble sold by the producers in the United States, 1922–1923, by States

[Quantities approximate]

State	1922		1923	
	Short tons	Value	Short tons	Value
Alabama	[a] 25, 850	[a] $591, 971	[b] 24, 970	[b] $958, 189
Alaska	[a] 5, 140	[a] 169, 635	[b] 11, 110	[b] 377, 622
Arkansas	([a])	([a])	([b])	([b])
California	27, 130	186, 352	40, 500	209, 469
Colorado	([a])	([a])	([b])	([b])
Georgia	61, 350	1, 867, 228	56, 230	2, 090, 486
Maryland	[a] 21, 680	[a] 178, 169	[b] 14, 040	[b] 171, 250
Massachusetts	12, 830	274, 769	17, 950	277, 625
Michigan	----------	----------	([b])	([b])
Missouri	37, 250	816, 098	57, 260	1, 085, 122
New Jersey	([a])	([a])	([b])	([b])
New Mexico	([a])	([a])	----------	----------
New York	52, 870	336, 956	63, 570	412, 875
North Carolina	([a])	([a])	([b])	([b])
Pennsylvania	----------	----------	([b])	([b])
Tennessee	66, 680	2, 520, 517	101, 600	2, 706, 688
Texas	([a])	([a])	----------	----------
Utah	([a])	([a])	([b])	([b])
Vermont	117, 090	3, 592, 976	175, 330	4, 574, 648
Virginia	([a])	([a])	([b])	([b])
Washington	----------	----------	([b])	([b])
	427, 870	10, 534, 671	562, 560	12, 863, 974

[a] Alabama includes Arkansas, New Mexico, and Texas; Alaska includes Colorado and Utah; Maryland includes New Jersey, North Carolina, and Virginia.

[b] Alabama includes Arkansas; Alaska includes Colorado, Michigan, Utah, and Washington; Maryland includes New Jersey, North Carolina, Pennsylvania, and Virginia.

SERPENTINE

The figures showing sales of serpentine (verde antique) in the United States for interior and exterior building, dimension stone, and by-products are included in this report in the figures for marble, but those showing sales of serpentine as crushed stone for road metal, ballast, riprap, and other low-grade material and as especially prepared crushed stone for terrazzo, stucco, and flour are included in the figures for "miscellaneous" stone. The total output of serpentine is given in the following table:

Serpentine (verde antique) sold or used by the producers in the United States, 1922 and 1923, by uses

Use	1922		1923	
	Quantity	Value	Quantity	Value
Building and ornamental stone.....cubic feet..	35, 510	$142, 988	56, 712	$365, 668
Rough construction, crushed, etc.....short tons..	18, 387	108, 284	11, 203	88, 904
	....	251, 272	....	454, 572

LIMESTONE

SUMMARY

The output of limestone as shown in this report was 30 per cent more in 1923 than in 1922. All the important items showed increases. Building stone increased 16 per cent, crushed stone 26 per cent, fluxing stone 37 per cent, agricultural limestone 7 per cent, and limestone for miscellaneous uses, chiefly manufacturing industries, 39 per cent.

Limestone sold or used by the producers in the United States, 1922 and 1923, by uses

Use	1922		1923	
	Quantity	Value	Quantity	Value
Building stone.....cubic feet..	[a]12, 617, 380	[a]$12,418,873	[a]14, 639, 950	[a]$16, 221, 095
Approximate equivalent in short tons.....	[a]955, 540	....	[a]1, 099, 390	....
Curbing, flagging, and paving.....cubic feet..	([a])	([a])	75, 070	46, 830
Approximate equivalent in short tons.....	([a])	....	6, 600	....
Rubble.....short tons..	286, 340	470, 264	327, 180	484, 771
Riprap.....do....	1, 010, 850	925, 760	1, 536, 570	1, 451, 670
Crushed stone.....do....	32, 786, 300	33, 224, 879	41, 386, 550	42, 540, 754
Fluxing stone.....long tons..	16, 687, 740	14, 208, 457	22, 823, 340	20, 333, 939
Equivalent in short tons.....	18, 690, 270	....	25, 562, 140	....
Sugar factories.....short tons..	371, 430	634, 511	474, 530	875, 774
Glass factories.....do....	166, 070	291, 854	197, 380	301, 403
Paper mills.....do....	149, 430	264, 130	206, 740	326, 054
Agriculture.....do....	1, 195, 000	2, 150, 435	1, 278, 770	2, 160, 249
Other uses[b].....do....	3, 317, 430	3, 808, 764	4, 625, 510	4, 877, 468
Total (quantities approximate, in short tons).....	58, 928, 660	68, 397, 927	76, 701, 360	89, 620, 007

[a] Figures for building stone include small amounts for monuments, curbing, and flagging in 1922, and for monuments in 1923.

[b] See table on p. 224 for further distribution of limestone products.

Limestone sold or used by the producers in the United States, 1922 and 1923, by States

[Quantities approximate]

State	1922		1923	
	Short tons	Value	Short tons	Value
Alabama	830, 160	$787, 040	1, 253, 500	$1, 362, 084
Arizona	59, 250	52, 597	87, 900	89, 576
Arkansas	80, 810	72, 803	119, 800	121, 169
California	216, 520	384, 732	355, 150	629, 108
Colorado	393, 260	381, 269	386, 120	431, 374
Connecticut	6, 220	22, 737	(a)	(a)
Florida	770, 140	706, 644	1, 412, 410	1, 236, 226
Georgia	161, 980	424, 242	175, 380	389, 511
Idaho	35, 410	67, 637	32, 020	61, 758
Illinois	6, 690, 010	6, 423, 573	9, 020, 880	8, 309, 383
Indiana	2, 775, 740	13, 203, 146	3, 650, 110	17, 692, 112
Iowa	620, 710	657, 126	603, 550	698, 207
Kansas	633, 590	853, 436	907, 820	1, 156, 637
Kentucky	1, 442, 580	1, 653, 506	1, 835, 950	2, 075, 076
Louisiana	(a)	(a)	(a)	(a)
Maine	45, 310	99, 611	48, 040	108, 788
Maryland	439, 730	459, 528	625, 590	878, 745
Massachusetts	60, 810	234, 031	58, 410	189, 929
Michigan	7, 646, 550	4, 533, 998	10, 587, 070	5, 845, 649
Minnesota	250, 950	583, 467	329, 950	776, 162
Mississippi	(a)	(a)	(a)	(a)
Missouri	1, 559, 880	2, 409, 202	2, 068, 230	3, 173, 622
Montana	183, 100	153, 900	228, 940	187, 362
Nebraska	182, 960	231, 195	243, 920	328, 918
Nevada	(a)	(a)	16, 140	27, 603
New Jersey	264, 340	320, 855	394, 090	473, 416
New Mexico	(a)	(a)	(a)	(a)
New York	5, 859, 430	6, 512, 291	6, 413, 380	7, 463, 884
North Carolina	112, 860	157, 911	131, 920	202, 573
Ohio	8, 800, 680	7, 473, 525	11, 135, 610	9, 123, 061
Oklahoma	1, 130, 360	1, 197, 082	1, 254, 740	1, 326, 266
Oregon	(a)	(a)	4, 020	13, 828
Pennsylvania	9, 736, 470	9, 848, 290	12, 558, 550	13, 753, 093
Porto Rico	90, 480	202, 710	86, 600	192, 661
Rhode Island	(a)	(a)	(a)	(a)
South Dakota	19, 340	32, 795	43, 280	70, 190
Tennessee	1, 024, 850	1, 239, 359	1, 352, 580	1, 634, 705
Texas	1, 238, 780	1, 074, 373	1, 834, 850	1, 616, 197
Utah	411, 000	355, 643	558, 140	457, 490
Vermont	17, 610	59, 008	27, 330	73, 318
Virginia	1, 368, 230	1, 527, 430	1, 995, 060	2, 220, 462
Washington	40, 380	94, 810	53, 540	116, 243
West Virginia	2, 157, 250	2, 126, 265	2, 531, 350	2, 634, 457
Wisconsin	1, 326, 700	1, 401, 820	1, 878, 220	2, 014, 942
Wyoming	101, 230	191, 124	186, 150	281, 595
Undistributed	143, 000	187, 216	215, 070	182, 627
	58, 928, 660	68, 397, 927	76, 701, 360	89, 620, 007

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[a] Included under “Undistributed.”

Limestone sold or used by the producers in the United States in 1923, by States and uses

State	Number of active plants	Building [a]						Rubble		Riprap		Crushed stone			
		Rough construction		Rough architectural		Dressed (sawed and cut)						Road metal and concrete		Railroad ballast	
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	20			(b)	(b)					30, 250	$25, 851	129, 000	$212, 001		
Arizona	6									(b)	(b)	(b)	(b)	(b)	(b)
Arkansas	5									2, 980	2, 860	115, 570	112, 759		
California	22	(b)	(b)							(b)	(b)	126, 300	130, 315	(b)	(b)
Colorado	14											15, 550	19, 438		
Connecticut	2											(b)	(b)		
Florida	17	(b)	(b)			(b)	(b)			12, 810	12, 625	961, 220	838, 318	207, 850	$208, 320
Georgia	8											78, 610	84, 589	(b)	(b)
Idaho	5														
Illinois	67	(b)	(b)	(b)	(b)	(b)	(b)	9, 220	$13, 043	488, 900	496, 293	5, 704, 900	5, 394, 165	1, 500, 060	1, 237, 584
Indiana	95			4, 792, 580	$2, 993, 984	6, 917, 800	$12,319,158	78, 940	77, 458	36, 790	17, 514	2, 115, 910	1, 775, 460	275, 030	221, 903
Iowa	32	(b)	(b)			(b)	(b)	8, 720	13, 150	35, 840	41, 172	449, 760	531, 026	28, 390	30, 144
Kansas	50	8, 790	$13, 427			18, 900	11, 220	15, 090	13, 385	17, 120	18, 454	614, 710	867, 346	240, 000	189, 067
Kentucky	91	2, 950	7, 022	(b)	(b)	(b)	(b)	5, 550	5, 802	48, 340	54, 298	1, 101, 720	1, 308, 327	624, 970	471, 496
Louisiana	1											(b)	(b)		
Maine	4														
Maryland	16	4, 070	4, 466							(b)	(b)	282, 620	483, 304	7, 820	10, 656
Massachusetts	6														
Michigan	20	12, 870	10, 117					1, 520	1, 961	(b)	(b)	1, 459, 090	1, 033, 883	144, 280	122, 648
Minnesota	19	(b)	(b)	39, 930	40, 820	110, 600	292, 795	5, 010	8, 090	35, 160	39, 795	253, 740	348, 571		
Mississippi	2														
Missouri	106	6, 130	11, 125					150, 970	273, 111	252, 170	331, 680	1, 417, 770	2, 165, 653	90, 960	100, 955
Montana	8							(b)	(b)	33, 440	34, 452				
Nebraska	11									52, 000	56, 205	158, 510	185, 594	(b)	(b)
Nevada	3									(b)	(b)				
New Jersey	12											26, 660	46, 207		
New Mexico	2											(b)	(b)	(b)	(b)
New York	84	87, 940	87, 055	(b)	(b)	(b)	(b)	2, 620	2, 992	(b)	(b)	4, 510, 760	5, 265, 339	699, 050	631, 678
North Carolina	4											106, 290	138, 777	(b)	(b)
Ohio	124	19, 470	20, 244			35, 000	20, 000	2, 630	4, 300	3, 710	5, 530	5, 299, 580	4, 694, 926	1, 194, 920	972, 550
Oklahoma	21	(b)	(b)			(b)	(b)	(b)	(b)	38, 500	36, 014	767, 070	928, 609	443, 170	351, 909
Oregon	2														
Pennsylvania	280	29, 160	38, 648					2, 300	2, 903			3, 007, 310	4, 231, 112	64, 590	73, 756
Porto Rico	12											71, 120	140, 844	(b)	(b)
Rhode Island	1														
South Dakota	6									(b)	(b)	25, 660	45, 090		

[a] Figures for building stone include small amounts for monumental work.

[b] Included under "Undistributed."

Limestone sold or used by the producers in the United States in 1923, by States and uses—Continued

State	Number of active plants	Building						Rubble		Riprap		Crushed stone			
		Rough construction		Rough architectural		Dressed (sawed and cut)						Road metal and concrete		Railroad ballast	
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Tennessee	32											620, 490	$668, 091	466, 040	$380, 604
Texas	24	12, 510	$12, 310	79, 240	$39, 670	(b)	(b)	(b)	(b)	47, 570	$46, 245	1, 150, 140	1, 072, 342	538, 110	347, 390
Utah	9									(b)	(b)			(b)	(b)
Vermont	9	530	788									12, 290	17, 817		
Virginia	48							50	$100			852, 030	1, 065, 043	713, 200	652, 327
Washington	5											(b)	(b)		
West Virginia	26											365, 460	420, 810	319, 150	208, 772
Wisconsin	92	10, 090	14, 548					15, 930	31, 934	72, 870	54, 844	1, 552, 160	1, 663, 769	90, 920	67, 963
Wyoming	14							(b)	(b)	24, 250	11, 975	(b)	(b)	(b)	(b)
Undistributed		15, 800	19, 055	120, 090	110, 458	110, 510	$154, 185	28, 630	36, 542	303, 870	165, 863	30, 210	36, 184	355, 830	335, 323
	1, 437	210, 310	238, 805	5, 031, 840	3, 184, 932	7, 192, 810	12, 797, 358	327, 180	484, 771	1, 536, 570	1, 451, 670	33, 382, 210	35, 925, 709	8, 004, 340	6, 615, 045
Average value			$1. 14		$0. 63		$1. 78		$1. 48		$0. 94		$1. 08		$0. 83

State	Number of active plants	Fluxing stone		Sugar factories		Glass factories		Paper mills		Agriculture		Other uses		Total	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Alabama	20	1, 084, 310	$1, 049, 022							990	$1, 374	4, 150	$19, 836	1, 253, 500	$1, 362, 084
Arizona	6	57, 250	64, 075											87, 900	89, 576
Arkansas	5							(b)	(b)	(b)	(b)			119, 800	121, 169
California	22	19, 280	49, 568	(b)	(b)	(b)	(b)	(b)	(b)	33, 900	71, 019	48, 570	142, 370	355, 150	629, 108
Colorado	14	265, 300	242, 674	61, 100	$117, 595							44, 170	51, 667	386, 120	431, 374
Connecticut	2	(b)	(b)							(b)	(b)			(b)	(b)
Florida	17									(b)	(b)	225, 750	167, 655	1, 412, 410	1, 236, 226
Georgia	8	(b)	(b)							23, 300	46, 301	50, 490	238, 345	175, 380	389, 511
Idaho	5	(b)	(b)	(b)	(b)			(b)	(b)	(b)	(b)	(b)	(b)	32, 020	61, 758
Illinois	67	874, 670	722, 496			(b)	(b)			350, 550	306, 191	72, 940	106, 574	9, 020, 880	8, 309, 383
Indiana	95	114, 490	72, 073	(b)	(b)	57, 730	$74, 683	(b)	(b)	90, 160	78, 690	14, 900	44, 592	3, 650, 110	17, 692, 112
Iowa	32	15, 120	19, 110	12, 000	22, 128					50, 810	35, 997			603, 550	698, 207

Kansas	50	(b)	(b)					(b)	(b)	(b)	(b)	(b)	(b)	907, 820	1, 156, 637
Kentucky	91	17, 270	13, 102							18, 080	19, 477	7, 450	32, 094	1, 835, 950	2, 075, 076
Louisiana	1													(b)	(b)
Maine	4	(b)	(b)					(b)	(b)	(b)	(b)	(b)	(b)	48, 040	108, 788
Maryland	16	(b)	(b)			(b)	(b)			(b)	(b)	14, 210	103, 424	625, 590	878, 745
Massachusetts	6	(b)	(b)							43, 380	128, 429	(b)	(b)	58, 410	189, 929
Michigan	20	6, 413, 290	3, 129, 104	(b)	(b)			110, 300	$147, 909	164, 790	108, 554	2, 210, 160	1, 186, 221	10, 587, 070	5, 845, 649
Minnesota	19	(b)	(b)							15, 710	13, 728	7, 450	30, 618	329, 950	776, 162
Mississippi	2									(b)	(b)			(b)	(b)
Missouri	106	37, 440	51, 157	(b)	(b)	27, 050	40, 646			30, 800	42, 285	49, 860	150, 367	2, 068, 230	3, 173, 622
Montana	8	164, 880	105, 273	(b)	(b)	(b)	(b)			(b)	(b)			228, 940	187, 362
Nebraska	11	4, 980	7, 903	4, 380	9, 599					(b)	(b)	(b)	(b)	243, 920	328, 918
Nevada	3	(b)	(b)	(b)	(b)							(b)	(b)	16, 140	27, 603
New Jersey	12	334, 640	335, 033	40	58					26, 370	73, 470	6, 380	18, 648	394, 090	473, 416
New Mexico	2													(b)	(b)
New York	84	168, 220	165, 395					16, 620	23, 668	68, 620	218, 513	852, 400	1, 051, 850	6, 413, 380	7, 463, 884
North Carolina	4	(b)	(b)							(b)	(b)			131, 920	202, 573
Ohio	124	4, 138, 040	2, 897, 532	1, 160	1, 741	26, 950	29, 281			53, 910	101, 793	392, 260	375, 164	11, 135, 610	9, 123, 061
Oklahoma	21					(b)	(b)			(b)	(b)			1, 254, 740	1, 326, 266
Oregon	2							(b)	(b)	(b)	(b)			4, 020	13, 828
Pennsylvania	280	9, 037, 150	8, 616, 237			62, 440	114, 342	27, 280	35, 868	95, 170	329, 210	233, 150	311, 017	12, 558, 550	13, 753, 093
Porto Rico	12			(b)	(b)					6, 980	43, 600			86, 600	192, 661
Rhode Island	1	(b)	(b)											(b)	(b)
South Dakota	6			(b)	(b)									43, 280	70, 190
Tennessee	32	134, 510	133, 904							57, 310	128, 716	74, 230	323, 390	1, 352, 580	1, 634, 705
Texas	24	50, 030	50, 043			(b)	(b)			(b)	(b)	(b)	(b)	1, 834, 850	1, 616, 197
Utah	9	202, 100	159, 877	81, 100	158,588									558, 140	457, 490
Vermont	9	1, 370	3, 821							13, 140	50, 892			27, 330	73, 318
Virginia	48	165, 170	136, 253							24, 580	53, 128	240, 030	313, 611	1, 995, 060	2, 220, 462
Washington	5	31, 210	79, 877					10, 910	17, 403	(b)	(b)	(b)	(b)	53, 540	116, 243
West Virginia	26	1, 807, 930	1, 840, 837							38, 810	164, 038			2, 531, 350	2, 634, 457
Wisconsin	92	70, 580	58, 432							27, 540	49, 060	38, 130	74, 392	1, 878, 220	2, 014, 942
Wyoming	14	(b)	(b)	118, 140	238, 091									186, 150	281, 595
Undistributed		352, 910	331, 141	196, 610	327, 974	23, 210	42, 451	41, 630	101, 206	43, 870	95, 784	45, 430	182, 463	215, 070	182, 627
	1, 437	25, 562, 140	20, 333, 939	474, 530	875, 774	197, 380	301, 403	206, 740	326, 054	1, 278, 770	2, 160, 249	[c]4,632,110	[c]4,924,298	76, 701, 360	89, 620, 007
Average value			$0. 80		$1. 85		$1. 53		$1. 58		$1. 69		$1. 06		$1. 17

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[b] Included under "Undistributed."

[c] Includes 75,070 cubic feet of curbing, flagging, and paving, valued at $46,830.

Limestone sold or used by producers in the United States for miscellaneous uses, 1922 and 1923

Use	1922		1923	
	Short tons	Value	Short tons	Value
Alkali works	2,494,260	$1,878,702	3,338,910	$2,348,223
Calcium carbide works	256,190	117,939	276,760	138,854
Refractory stone (dolomite)	146,640	172,251	205,890	249,993
Whiting substitute	66,200	405,783	81,310	514,258
Magnesia works	53,170	79,313	116,410	146,337
Asphalt filler	138,930	549,281	225,400	728,386
Mineral wool	9,170	10,622	6,940	9,333
Carbolic acid works	3,950	3,707		
Carbonic acid works	26,890	53,357	19,830	37,164
Poultry grit	10,792	71,213	13,080	77,004
Lime burners	8,100	4,292	(a)	(a)
Stucco	62,870	382,792	66,590	392,591
Roofing gravel	(a)	(a)	11,060	27,272
Other uses [b]	40,268	79,512	263,330	208,053
	3,317,430	3,808,764	4,625,510	4,877,468

[a] Included under "Other uses."

[b] Includes stone sold for manufacture of sulphuric acid, phosphates, terrazzo, artificial stone, ammonia, nitrates, soap, baking powder and other chemicals, the purification of copper, filter stone, road base, livestock mixture, and uses not specified; also roofing gravel in 1922 and for lime burners in 1923.

A considerable quantity of the limestone reported in the tables by uses is burned into lime—particularly the limestone reported by iron and steel producers and by alkali, sugar, and paper manufacturers, quarried by them and used in their own plants; also limestone sold to the manufacturers of these and other commodities who may burn it into lime before using it. To avoid duplication this lime is not included in the figures of production in the chapter on lime. Limestone manufactured into lime and into cement and reported in terms of finished product is treated in separate chapters, and the limestone used in their manufacture is estimated in the following table:

Limestone used for all purposes in the United States, 1921–1923, in short tons

Use	1921	1922	1923
Limestone (as given in this report)	45,621,000	58,928,660	76,701,360
Portland cement (including "cement rock")	24,400,000	30,070,000	34,722,000
Natural cement ("cement rock")	90,000	148,000	212,000
Lime	5,060,000	7,280,000	8,140,000
	75,171,000	96,426,660	119,775,360

BUILDING STONE

The report on stone for 1922 gave the locations of the principal limestone quarries whose product is used for building stone, and the names of the operators. The statistics for the Indiana oolitic limestone district, the limestone (marble) district around Carthage, Mo., and the districts of Mankato and Kasota, Minn., are given below in continuation of tables published yearly.

Indiana.—The figures for the Bedford-Bloomington oolitic limestone district, in Lawrence and Monroe counties, Ind., as given below, differ from those published in former reports in that a further separation of dressed stone is made in order to show the semifinished molded and machine stone furnished to cut-stone plants for further dressing before being placed in the building.

The quantity of building stone reported in 1923 is greater than has ever been reported before, being 12 per cent more than the greatest annual output previously recorded—that for 1912—and 22 per cent more than that for 1922.

Limestone sold by the producers in the Bedford-Bloomington district, Lawrence and Monroe counties, Ind., in 1923

County	Number of active plants	Building stone [a]							
		Rough blocks		Sawed stone		Semifinished stone		Cut stone	
		Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
Lawrence	12	3, 369, 350	$2,226,150	1, 796, 380	$1,921,789	401, 450	$861, 123	1, 609, 400	$5, 263, 255
Monroe	24	1, 423, 230	767, 834	2, 507, 480	2, 434, 795	176, 260	391, 808	410, 830	1, 381, 410
	36	4, 792, 580	2, 993, 984	4, 303, 860	4, 356, 584	577, 710	1, 252, 931	2, 020, 230	6, 644, 665
Average value			$0. 62		$1. 01		$2. 17		$3. 29
Total, 1922	30	4, 189, 547	2. 443, 207	3, 635, 744	3, 427, 898	[b] 1, 791, 379	[b] 5, 417, 718	([b])	([b])

County	Number of active plants	Building stone [a]		Other		Total	
		Total					
		Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
Lawrence	12	7, 176, 580	$10, 272, 317	228, 320	$166, 894	748, 620	$10, 439, 211
Monroe	24	4, 517, 800	4, 975, 847	4, 860	951	332, 460	4, 976, 798
	36	11, 694, 380	15, 248, 164	233, 180	167. 845	1, 081, 080	15, 416, 009
Average value			$1. 30		$0. 72		
Total, 1922	30	9, 616, 670	11, 288, 823	214, 722	139, 233	912, 000	11, 428, 056

[a] Includes in 1922 a small amount of stone sold for monumental work, curbing, and flagging.
[b] Cut stone included under "Semifinished stone."

A considerable amount of stone is sold by the quarry operators to the finishing mills of the district. The dressed stone sold by these mills is shown in the following table.

Indiana oolitic limestone sold by the mills not operated by quarry companies in the Bedford-Bloomington district, Lawrence and Monroe counties, Ind., 1921–1923

Year	Cubic feet	Value
1921	1, 030, 177	$2, 691, 931
1922	1, 508, 100	3, 706, 900
1923	1, 676, 500	4, 805, 537

Minnesota.—The following table shows the sales of stone at Mankato and Kasota, Minn., for the last three years:

Stone sold at Mankato and Kasota, Minn., 1921–1923

Year	Building stone (rough and dressed)		Other		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1921	111,487	$271,230	32,627	$41,409	41,500	$312,639
1922	151,110	261,275	29,910	32,329	42,600	293,604
1923	138,890	312,911	33,980	34,867	44,900	347,778

Missouri.—The stone from the Carthage district, Mo., used for architectural building and for monumental work is classed as marble and is included in the figures of production of marble in Missouri given on page 218. The crushed stone and low-grade material are included under limestone, but all grades are combined to show the total production in the table below.

Limestone and marble sold in the Carthage district, Jasper County, Mo., 1921–1923

Year	Building stone (rough and dressed)		Monumental stone (rough and dressed)		Other		Total	
	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1921	279,560	$587,301	31,551	$77,421	46,751	$152,521	72,600	$817,243
1922	368,400	692,693	26,330	40,471	68,550	176,852	102,300	910,016
1923	442,680	782,796	20,630	32,243	66,070	167,357	104,760	982,396

A considerable quantity of marble was also quarried at Phenix, Mo., for use in interior building. In 1923 these quarries sold 203,640 cubic feet of stone, 14 per cent more than in 1922. About 2,700 cubic feet of marble was also sold for building stone from recently opened quarries near Ste. Genevieve.

SANDSTONE

SUMMARY

The output of all sandstone products in 1923 except paving blocks and flagging increased. These products, however, formed only small parts of the total output, which showed an increase of 28 per cent. The report on stone for 1922 contained the names of the principal operators of sandstone quarries and the location of their quarries. The record of sandstone sold or used by the producers in 1922 and 1923 is given in the following tables.

Sandstone sold or used by the producers in the United States, 1922 and 1923, by uses

Use	1922		1923	
	Quantity	Value	Quantity	Value
Building stone.....cubic feet..	2,966,400	$1,947,557	3,229,450	$2,130,552
Approximate equivalent in short tons	243,900	------	245,870	------
Paving blocks.....number..	5,371,260	445,541	4,608,720	416,966
Approximate equivalent in short tons	55,140	------	44,700	------
Curbing.....cubic feet..	1,811,980	1,237,092	[a] 1,834,686	1,453,271
Approximate equivalent in short tons	148,690	------	[a] 136,840	------
Flagging.....cubic feet..	650,590	406,731	607,596	422,059
Approximate equivalent in short tons	53,580	------	43,860	------
Crushed stone.....short tons..	1,947,780	2,342,521	2,260,670	2,628,935
Riprap.....do....	103,040	99,155	341,120	441,634
Rubble.....do....	105,420	128,859	330,090	427,591
Refractory stone (ganister).....do....	724,860	881,314	907,670	1,182,635
Other uses.....do....	5,720	32,274	38,450	71,063
Total (quantities approximate, in short tons).....	3,388,130	7,521,044	4,349,270	9,174,706

[a] Apparent discrepancy—decrease in tonnage despite increase in footage as compared with 1922—is due to revision in factor of conversion. The increase as shown by footage is correct.

Sandstone sold or used by the producers in the United States, 1922 and 1923, by States

[Quantities approximate]

State	1922		1923	
	Short tons	Value	Short tons	Value
Alabama	33,750	$41,395	45,660	$39,609
Arizona	4,550	2,639	43,730	46,344
Arkansas	(a)	(a)	(a)	(a)
California	456,560	599,815	647,980	835,138
Colorado	32,740	41,695	69,140	113,841
Connecticut	(a)	(a)	(a)	(a)
Idaho	1,240	2,779	(a)	(a)
Illinois	91,300	49,993	90,950	49,173
Iowa	(a)	(a)	(a)	(a)
Kansas	24,070	42,040	11,820	23,760
Kentucky	95,110	200,345	48,430	174,949
Louisiana	1,070	1,068	(a)	(a)
Maryland	(a)	(a)	(a)	(a)
Massachusetts	2,260	56,342	2,510	98,147
Michigan	(a)	(a)	19,030	36,963
Minnesota	79,420	159,548	126,010	269,177
Missouri	920	12,279	160	2,978
Montana	(a)	(a)	6,360	23,848
New Jersey	10,200	13,200	20,120	26,600
New Mexico	194,000	113,140	216,180	122,663
New York	[b] 332,160	[b] 1,372,429	[b] 282,690	[b] 1,259,257
Ohio	336,800	2,091,115	357,730	2,341,508
Oklahoma	6,070	8,810	4,820	4,671
Oregon	------	------	148,200	207,680
Pennsylvania	[b] 1,240,560	[b] 2,005,125	[b] 1,405,330	[b] 2,359,306
South Dakota	99,780	148,723	192,740	284,127
Tennessee	(a)	(a)	------	------
Texas	------	------	(a)	(a)
Utah	------	------	225,700	116,601
Vermont	------	------	7,000	13,500
Virginia	52,870	17,420	48,380	27,724
Washington	(a)	(a)	(a)	(a)
West Virginia	6,220	8,679	19,360	25,958
Wisconsin	226,480	381,637	240,380	411,994
Wyoming	(a)	(a)	(a)	(a)
Undistributed	60,000	150,828	68,860	259,190
	3,388,130	7,521,044	4,349,270	9,174,706

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[a] Included under "Undistributed."
[b] Includes bluestone.

Sandstone sold or used by the producers in the United States in 1923, by States and uses

State	Number of active plants	Building						Refractory stone (ganister)		Paving blocks		Curbing	
		Rough construction		Rough architectural		Dressed (sawed and cut)							
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Number	Value	Cubic feet	Value
Alabama	6							29, 430	$33, 500				
Arizona	4							[a]	[a]				
Arkansas	2											[a]	[a]
California	14	[a]	[a]	[a]	[a]			3, 520	10, 204				
Colorado	17	570	$1, 218	30, 460	$13, 514	2, 080	$2, 847	28, 780	35, 400	18, 000	$1, 260		
Connecticut	3	[a]	[a]										
Idaho	1			[a]	[a]								
Illinois	4							2, 600	4, 437				
Iowa	1	[a]	[a]										
Kansas	3	[a]	[a]			[a]	[a]						
Kentucky	5	[a]	[a]	[a]	[a]	154, 320	144, 716						
Louisiana	1												
Maryland	1							[a]	[a]				
Massachusetts	2	360	270	12, 400	18, 600	12, 570	79, 200						
Michigan	4	[a]	[a]			[a]	[a]						
Minnesota	7	8, 020	44, 113	7, 740	6, 929	6, 920	11, 245	1, 100	1, 103	109, 630	12, 351		
Missouri	1					1, 990	2, 978						
Montana	3			160	106	1, 460	8, 030	6, 180	15, 665				
New Jersey	4	20, 120	26, 600										
New Mexico	3												
New York	39	2, 930	4, 531	83, 980	36, 026	181, 680	257, 669			1, 597, 930	114, 937	567, 540	$563, 335
Ohio	17	4, 140	8, 417	522, 570	270, 808	759, 970	758, 365	19, 330	45, 801			1, 140, 226	767, 046
Oklahoma	4	1, 120	1, 321										
Oregon	2												
Pennsylvania	105	41, 380	84, 794	4, 750	4, 381	36, 830	129, 003	637, 850	814, 910	1, 721, 440	170, 996	123, 390	118, 535
South Dakota	8			250	224			[a]	[a]	4, 680	353		
Texas	1												
Utah	4					[a]	[a]			[a]	[a]		
Vermont	1												
Virginia	4	[a]	[a]			[a]	[a]						
Washington	1					[a]	[a]			[a]	[a]		
West Virginia	6							990	1, 286				
Wisconsin	15	5, 640	5, 234	12, 840	14, 254	14, 230	40, 913	158, 420	199, 655	892, 350	85, 644	[a]	[a]
Wyoming	1												
Undistributed		16, 010	24, 593	25, 090	10, 429	96, 650	119, 224	19, 470	20, 674	264, 690	31, 425	3, 530	4, 355
	294	100, 290	201, 091	700, 240	375, 271	1, 268, 700	1, 554, 190	907, 670	1, 182, 635	4, 608, 720	416, 966	1, 834, 686	1, 453, 271
Average value			$2. 01		$0. 54		$1. 23		$1. 30		[b] $90. 47		$0. 79

State	Number of active plants	Flagging		Rubble		Riprap		Crushed stone				Other uses		Total	
								Road metal and concrete		Railroad ballast					
		Cubic feet	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Alabama	6			(a)	(a)	(a)	(a)							45, 660	$39, 609
Arizona	4					(a)	(a)							43, 730	46, 344
Arkansas	2					(a)	(a)	(a)	(a)					(a)	(a)
California	14			(a)	(a)			345, 370	$439, 543	10, 400	$16, 908	(a)	(a)	647, 980	835, 138
Colorado	17	3, 350	$1, 607	2, 170	$3, 652	9, 900	$11, 167	24, 670	43, 176					69, 140	113, 841
Connecticut	3													(a)	(a)
Idaho	1													(a)	(a)
Illinois	4							88, 350	44, 736					90, 950	49, 173
Iowa	1													(a)	(a)
Kansas	3	(a)	(a)					(a)	(a)					11, 820	23, 760
Kentucky	5					(a)	(a)	(a)	(a)					48, 430	174, 949
Louisiana	1					(a)	(a)	(a)	(a)					(a)	(a)
Maryland	1													(a)	(a)
Massachusetts	2			100	77									2, 510	98, 147
Michigan	4			(a)	(a)			12, 830	28, 870					19, 030	36, 963
Minnesota	7					(a)	(a)	107, 940	168, 902			(a)	(a)	126, 010	269, 177
Missouri	1													160	2, 978
Montana	3			50	47									6, 360	23, 848
New Jersey	4													20, 120	26, 600
New Mexico	3			(a)	(a)					(a)	(a)			216, 180	122, 663
New York	39	59, 900	43, 417	15, 000	10, 000	2, 140	1, 489	168, 780	223, 401	(a)	(a)	(a)	(a)	282, 690	1, 259, 257
Ohio	17	503, 480	330, 249	9, 400	14, 774	81, 840	86, 611	33, 370	41, 463	300	119	4, 580	$17, 855	357, 730	2, 341, 508
Oklahoma	4			3, 700	3, 350									4, 820	4, 671
Oregon	2					122, 500	182, 650	25, 700	25, 030					148, 200	207, 680
Pennsylvania	105	39, 886	46, 440	14, 740	28, 965	8, 190	15, 629	448, 030	686, 858	206, 480	247, 529	15, 610	11, 266	1, 405, 330	2, 359, 306
South Dakota	8					(a)	(a)	168, 750	245, 166			3, 700	18, 370	192, 740	284, 127
Texas	1							(a)	(a)					(a)	(a)
Utah	4			(a)	(a)	8, 730	13, 463			216, 600	101, 879			225, 700	116, 601
Vermont	1							7, 000	13, 500					7, 000	13, 500
Virginia	4	(a)	(a)							47, 950	26, 240			48, 380	27, 724
Washington	1					(a)	(a)							(a)	(a)
West Virginia	6			560	421			17, 070	23, 302	720	915	20	34	19, 360	25, 958
Wisconsin	15			3, 050	2, 842	13, 050	6, 810	(a)	(a)			(a)	(a)	240, 380	411, 994
Wyoming	1					(a)	(a)	(a)	(a)					(a)	(a)
Undistributed		980	346	281, 320	363, 463	94, 770	123, 815	112, 440	126, 283	217, 920	125, 115	14, 540	23, 538	68, 860	259, 190
	294	607, 596	422, 059	330, 090	427, 591	341, 120	441, 634	1, 560, 300	2, 110, 230	700, 370	518, 705	38, 450	71, 063	4, 349, 270	9, 174, 706
Average value			$0. 69		$1. 30		$1. 29		$1. 35		$0. 74		$1. 85		$2. 11

[a] Included under "Undistributed."

[b] Per thousand.

BLUESTONE

The figures of production for bluestone are included in those of sandstone, but on account of the local importance of this stone they are also given separately. Except for a few of the large quarries the figures of sales reported by dealers rather than quarrymen are used by the Geological Survey, as more nearly representative of this industry. Stone for curbing decreased, and stone for building and flagging, the other important products, increased.

Bluestone sold in New York and Pennsylvania, 1922 and 1923

State	Building stone		Curbing		Flagging		Other		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1922										
New York	134,300	$247,665	380,000	$305,921	46,000	$40,663	8,370	$10,158	55,660	$604,407
Pennsylvania	22,550	12,789	100,500	64,319	39,480	25,984	14,680	19,078	28,600	122,170
	156,850	260,454	480,500	370,240	85,480	66,647	23,050	29,236	84,260	726,577
Average value		$1.66		$0.77		$0.78		$1.27		
1923										
New York	145,660	240,596	268,150	316,801	57,400	41,917	7,450	12,324	47,260	611,638
Pennsylvania	13,730	6,913	93,800	94,915	39,620	46,280	100	300	12,250	148,408
	159,390	247,509	361,950	411,716	97,020	88,197	7,550	12,624	59,510	760,046
Average value		$1.55		$1.14		$0.91		$1.67		

MISCELLANEOUS STONE

Practically all the material included under "miscellaneous stone" is used for road metal, concrete, and railroad ballast. Much of this material is quarried for jobs near the quarries, which are closed when the work is done. Among the varieties of stone included under this heading are argillite, quarried in Arkansas; rhyolite tuff (used as a building stone), andesite, rhyolite, trachyte, and other light-colored volcanic rocks, decomposed granite, and stone crushed from boulders taken from river beds, in California; phonolite from mine dumps, in Colorado; cherty limestone or flint rock, in Florida; rhyolite, in Idaho and North Carolina; slate, conglomerate, and light-colored volcanic rocks, in Massachusetts; and argillite for crushed stone and mica schist for building and refractory stone, in Pennsylvania. The figures also include some stone, the variety of which is not known, reported by local contractors or operators of portable crushers as the product of roadside workings. There was a large increase in the output of miscellaneous stone during 1923.

Miscellaneous varieties of stone [a] *sold or used by the producers in the United States, 1922 and 1923, by uses*

Use	1922		1923	
	Quantity	Value	Quantity	Value
Building stone .... cubic feet..	1,053,320	$141,769	411,310	$140,751
Approximate equivalent in short tons	88,480		33,500	
Riprap and rubble .... short tons..	50,670	42,250	236,960	192,882
Crushed stone .... do....	1,328,900	1,493,433	3,418,530	4,055,225
Refractory stone (mica schist) .... do....	30,670	82,671	38,340	140,166
Other uses .... do....	22,160	126,683	3,540	38,086
Total (quantities approximate, in short tons)	1,520,880	1,886,806	3,730,870	4,567,110

[a] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, and such other stone as can not be properly classed in any of the main groups.

Miscellaneous varieties of stone sold or used by the producers in the United States, 1922 and 1923, by States

[Quantities approximate]

State	1922		1923	
	Short tons	Value	Short tons	Value
Arizona	10,030	$14,385	14,290	$19,054
Arkansas	([a])	([a])	355,790	425,064
California	801,680	702,165	2,393,190	2,470,823
Colorado			41,130	14,227
Florida	([a])	([a])	81,670	189,208
Idaho	([a])	([a])	26,710	30,473
Massachusetts	239,030	361,682	223,380	408,027
Nevada			([a])	([a])
New Hampshire	11,690	23,217	8,410	31,926
New Jersey	([a])	([a])	([a])	([a])
New York	([a])	([a])	([a])	([a])
North Carolina			([a])	([a])
Oklahoma			([a])	([a])
Oregon	([a])	([a])	35,760	19,385
Pennsylvania	128,690	261,049	141,370	344,648
Rhode Island	36,670	73,513	77,330	142,220
South Dakota	4,000	5,680	3,400	3,571
Virginia	([a])	([a])	([a])	([a])
Wisconsin	([a])	([a])		
Wyoming	([a])	([a])	([a])	([a])
Undistributed	289,090	445,115	328,440	468,484
	1,520,880	1,886,806	3,730,870	4,567,110

[a] Included under "Undistributed."

Miscellaneous varieties of stone sold or used by the producers in the United States in 1923, by States and uses

State	Number of active plants	Building		Riprap and rubble		Crushed stone for concrete and road metal	
		Short tons	Value	Short tons	Value	Short tons	Value
Arizona	1					7,790	$11,904
Arkansas	4					231,480	327,341
California	38	(a)	(a)	204,900	$163,874	2,182,960	2,275,613
Colorado	3	(a)	(a)			40,990	10,627
Florida	8					81,670	189,208
Idaho	4	260	$260			26,450	30,213
Massachusetts	14	7,530	16,746			215,850	391,281
Nevada	1						
New Hampshire	3					5,420	7,940
New Jersey	1	(a)	(a)			(a)	(a)
New York	2					(a)	(a)
North Carolina	2			(a)	(a)	(a)	(a)
Oklahoma	1					(a)	(a)
Oregon	3			(a)	(a)		
Pennsylvania	28	18,230	70,145			80,710	127,688
Rhode Island	5					77,330	142,220
South Dakota	1					3,400	3,571
Virginia	2					(a)	(a)
Wyoming	1						
Undistributed		7,480	53,600	32,060	29,008	200,330	318,884
	122	33,500	140,751	236,960	192,882	3,154,380	3,836,490
Average value			$4.20		$0.81		$1.22

State	Number of active plants	Crushed stone for railroad ballast		Other uses		Total	
		Short tons	Value	Short tons	Value	Short tons (approximate)	Value
Arizona	1	6,500	$7,150			14,290	$19,054
Arkansas	4	124,310	97,723			355,790	425,064
California	38	3,990	3,986	(a)	(a)	2,393,190	2,470,823
Colorado	3			(a)	(a)	41,130	14,227
Florida	8					81,670	189,208
Idaho	4					26,710	30,473
Massachusetts	14					223,380	408,027
Nevada	1	(a)	(a)			(a)	(a)
New Hampshire	3			2,990	$23,986	8,410	31,926
New Jersey	1					(a)	(a)
New York	2	(a)	(a)			(a)	(a)
North Carolina	2					(a)	(a)
Oklahoma	1	(a)	(a)			(a)	(a)
Oregon	3	35,460	19,245	(a)	(a)	35,760	19,385
Pennsylvania	28	4,090	6,649	38,340	140,166	141,370	344,648
Rhode Island	5					77,330	142,220
South Dakota	1					3,400	3,571
Virginia	2					(a)	(a)
Wyoming	1			(a)	(a)	(a)	(a)
Undistributed		89,800	83,982	550	14,100	328,440	468,484
	122	264,150	218.735	41,880	178,252	3,730,870	4,567,110
Average value			$0.83		$4.26		$1.22

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[a] Included under "Undistributed."

CRUSHED STONE

There was an increase of 25 per cent in both the quantity and value of the output of crushed stone in the United States in 1923 compared with 1922. Stone for road metal and concrete increased 20 per cent, and stone for railroad ballast 54 per cent. There was an increase of 2 cents in the average value of road metal and concrete and a decrease of 4 cents in that of railroad ballast. A special canvass of railroad companies was made in 1923 in order to obtain more complete reports of the noncommercial material quarried and used by them, and the figures thus obtained account to a certain extent for the considerable increase in this product and also for the decrease in average value, as such material almost always shows a lower value than commercial material. A canvass was also made of the highway departments of all the different States to find out if possible the amount of noncommercial material used by them. This canvass, however, was not wholly successful, as only a few of the States could give entirely satisfactory information.

Crushed stone sold or used by the producers in the United States, 1922 and 1923

Kind	Road metal and concrete		Railroad ballast		Total		
	Short tons	Value	Short tons	Value	Short tons	Value	
						Total	Average
1922							
Granite	3,614,250	$4,973,646	482,660	$441,430	4,096,910	$5,415,076	$1.32
Basalt and related rocks (trap rock)	8,313,670	10,284,048	1,290,180	1,370,220	9,603,850	11,654,268	1.21
Limestone	27,906,450	28,966,511	4,879,850	4,258,368	32,786,300	33,224,879	1.01
Sandstone	1,442,280	1,937,472	505,500	405,049	1,947,780	2,342,521	1.20
Miscellaneous	1,149,850	1,421,081	179,050	72,352	1,328,900	1,493,433	1.12
	42,426,500	47,582,758	7,337,240	6,547,419	49,763,740	54,130,177	------
Average value per ton	------------	$1.12	------------	$0.89	------------	$1.09	------
1923							
Granite	4,400,410	5,690,464	608,870	539,645	5,009,280	6,230,109	1.24
Basalt and related rocks (trap rock)	8,550,600	10,793,201	1,697,080	1,680,427	10,247,680	12,473,628	1.22
Limestone	33,382,210	35,925,709	8,004,340	6,615,045	41,386,550	42,540,754	1.03
Sandstone	1,560,300	2,110,230	700,370	518,705	2,260,670	2,628,935	1.16
Miscellaneous	3,154,380	3,836,490	264,150	218,735	3,418,530	4,055,225	1.19
	51,047,900	58,356,094	11,274,810	9,572,557	62,322,710	67,928,651	------
Average value per ton	------------	$1.14	------------	$0.85	------------	$1.09	------
Percentage of increase in 1923	20	23	54	46	25	25	------

Crushed stone sold or used by the producers in the United States in 1923, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	129, 000	$212, 001			129, 000	$212, 001
Arizona	[a] 7, 790	[a] 11, 904	[a] 6, 500	[a] $7, 150	54, 730	63, 269
Arkansas	[a] 355, 120	[a] 449, 256	124, 310	97, 723	[a] 479, 430	[a] 546, 979
California	5, 909, 830	5, 623, 348	612, 870	561, 075	6, 522, 700	6, 184, 423
Colorado	125, 010	129, 691			125, 010	129, 691
Connecticut	[a] 1,418, 880	[a] 1,507, 186	(b)	(b)	1, 440, 470	1, 525, 377
Delaware	(b)	(b)			(b)	(b)
Florida	1, 042, 890	1, 027, 526	207, 850	208, 320	1, 250, 740	1, 235, 846
Georgia	220, 050	254, 811	18, 980	16, 076	239, 030	270, 887
Hawaii	309, 010	544, 637			309, 010	544, 637
Idaho	[a] 140, 860	[a] 139, 579			[a] 140, 860	139, 579
Illinois	5, 793, 250	5, 438, 901	1, 500, 060	1, 237, 584	7, 293, 310	6, 676, 485
Indiana	2, 115, 910	1, 775, 460	275, 030	221, 903	2, 390, 940	1, 997, 363
Iowa	449, 760	531, 026	28, 390	30, 144	478, 150	561, 170
Kansas	[a] 614, 710	[a] 867, 346	240, 000	189, 067	[a] 854, 710	[a] 1, 056, 413
Kentucky	1, 101, 720	1, 308, 327	624, 970	471, 496	1, 726, 690	1, 779, 823
Louisiana	12, 810	14, 466			12, 810	14, 466
Maine	[a] 55, 570	[a] 106, 142	(b)	(b)	61, 540	115, 213
Maryland	559, 210	998, 554	210, 850	320, 664	770, 060	1, 319, 218
Massachusetts	1, 433, 870	2, 078, 653	22, 120	25, 876	1, 455, 990	2, 104, 529
Michigan	[a] 1,471, 920	[a] 1,062, 753	144, 280	122, 648	[a] 1,616, 200	[a] 1, 185, 401
Minnesota	509, 280	694, 907	(b)	(b)	[a] 509, 280	[a] 694, 907
Missouri	1, 417, 770	2, 165, 653	90, 960	100, 955	1, 508, 730	2, 266, 608
Nebraska	158, 510	185, 594	(b)	(b)	[a] 158, 510	[a] 185, 594
Nevada			(b)	(b)	(b)	(b)
New Hampshire	18, 540	29, 347			18, 540	29, 347
New Jersey	1, 494, 470	2, 332, 021	145, 870	170, 207	1, 640, 340	2, 502, 228
New Mexico	(b)	(b)	596, 790	402, 308	[a] 596, 790	[a] 402, 308
New York	4, 855, 540	5, 705, 624	779, 910	725, 191	5, 635, 450	6, 430, 815
North Carolina	[a] 1,097, 300	[a] 1,759, 114	[a] 109, 000	[a] 115, 000	[a] 1,206, 300	[a] 1, 874, 114
Ohio	5, 332, 950	4, 736, 389	1, 195, 220	972, 669	6, 528, 170	5, 709, 058
Oklahoma	[a] 767, 070	[a] 928, 609	443, 170	351, 909	[a] 1,210, 240	[a] 1, 280, 518
Oregon	715, 690	959, 434	197, 440	117, 927	913, 130	1, 077, 361
Pennsylvania	4, 550, 770	6, 367, 288	623, 470	762, 058	5, 174, 240	7, 129, 346
Porto Rico	71, 120	140, 844	(b)	(b)	[a] 71, 120	[a] 140, 844
Rhode Island	144, 970	299, 089			144, 970	299, 089
South Carolina	595, 600	976, 300	112, 000	124, 896	707, 600	1, 101, 196
South Dakota	197, 810	293, 827			197, 810	293, 827
Tennessee	620, 490	668, 091	466, 040	380, 604	1, 086, 530	1, 048, 695
Texas	[a] 1,150, 140	[a] 1,072, 342	[a] 538, 110	[a] 347, 390	2, 031, 480	1, 747, 253
Utah			[a] 216, 600	[a] 101, 879	[a] 216, 600	[a] 101, 879
Vermont	25, 080	40, 097			25, 080	40, 097
Virginia	964, 000	1, 216, 955	781, 550	696, 087	1, 745, 550	1, 913, 042
Washington	[a] 368, 370	[a] 448, 872	72, 330	14, 756	[a] 440, 700	[a] 463, 628
West Virginia	382, 530	444, 112	319, 870	209, 687	702, 400	653, 799
Wisconsin	[a] 1,846, 910	[a] 2,105, 310	90, 920	67, 963	[a] 1,937, 830	[a] 2, 173, 273
Wyoming	(b)	(b)	(b)	(b)	42, 770	21, 495
Undistributed	495, 820	704, 708	479, 350	401, 345	521, 170	685, 560
	51, 047, 900	58, 356, 094	11, 274, 810	9, 572, 557	62, 322, 710	67, 928, 651

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[a] Exclusive of certain kinds of stone included under "Undistributed" to avoid disclosing confidential information.

(b) Included under "Undistributed."

SILICA

By Frank J. Katz[1]

INTRODUCTION

Silica (SiO_2) occurs in deposits of commercial importance in many different forms, such as vein quartz, as a constituent of pegmatites, as sand, sandstone, quartzite, or flint, as tripoli, and as diatomaceous (infusorial) earth. In some forms, such as rose, smoky, and amethystine quartz, it has value as gems. This chapter deals with silica of all kinds except gem quartz, silica sand, or sandstone used for making glass, and silica used in the form of sand, gravel, and crushed material for building, for concrete and mortar, for foundry and furnace work, and for cutting and grinding stone. Such material as is not here included is either gem material or sand, is commercially so designated, and is therefore considered in other chapters of Mineral Resources. Tripoli and diatomaceous earth are to a large extent consumed as abrasives and are considered in the chapter on abrasive materials.

USES

Silica as considered in this chapter is used for many purposes, principally in the manufacture of pottery, paints, and scouring soaps, as a wood filler, as a polisher, and in metallurgical and chemical processes. In the pottery industry, where it is generally called flint, silica is used in the body of the ware to diminish shrinkage and is also used in glazes. Silica for use in pottery should contain less than 0.5 per cent of iron-bearing minerals. Manufacturers of paint use considerable quantities of very finely ground silica, which forms as much as one-third of the total pigment in some paints. For this purpose finely ground crystalline material is superior to fine sand in its natural state because of the angularity of the grains, which makes them adhere more firmly to the article painted and after wear affords a good surface for repainting. The same angularity makes artificially comminuted crystalline quartz superior to natural sand for use in wood fillers. For soaps and polishing powders ground material is preferred to natural sand on account of its whiteness and angularity. For all these purposes large quantities of pure quartz sand and sandstone are finely ground and yield a product fully equal to that obtained by grinding massive crystalline quartz.

Quartz crushed and graded to various sizes is used in making sandpaper and sand belts, as a scouring agent, for "frosting" glass with sand-blast apparatus, and for other purposes. Blocks of massive quartz and quartzite are used in the chemical industry as a filler for acid towers and as a flux in copper smelting. Crushed and ground quartz is also used in filters. Finely ground quartz is used in tooth powders and by dentists as a detergent. Silica of one form or another fused with soda ash makes sodium silicate ("water glass"), of which large quantities are manufactured for a great variety of uses.

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[1] Statistics prepared by Miss A. T. Coons.

Sand and crystalline quartz have been used in making silicon and alloys of silicon with iron, copper, and other metals in the electric furnace. Quartz may be fused in the electric furnace to make chemical apparatus, such as tubes, crucibles, and dishes. The report on silica in Mineral Resources for 1922 may be consulted for an account of the manufacture, properties, and uses of quartz glass thus made. The art of making fused quartz is nearly a hundred years old, but most of the early work was concerned with the opaque varieties made from sand. Only during the present century has progress been made in the development of clear fused quartz. The manufacture of high-quality fused quartz in small pieces has been possible for many years, but recently, according to Edward R. Berry, who is chiefly responsible for the new developments in the art, "advances in this new process have been so rapid and far-reaching that there seems to be no limit now to the size of high-quality clear fused quartz that can be made, except the limit that may be imposed by mechanical difficulties." Mr. Berry summarized recent developments in a paper presented at the Philadelphia meeting of the American Electrochemical Society, April 26, 1924.[2]

The material known commercially in the United States as tripoli, which is the siliceous residue of decomposed limestone, also yields an excellent grade of pulverized silica, which is used for the same purpose as silica powder obtained from massive crystalline quartz and from sand and sandstone. Diatomaceous (infusorial) earth is also used to make polishing powder and other products that are employed for uses similar to those for which quartz, sand, and tripoli powders are employed, but diatomaceous earth has somewhat different properties, and most of it finds different application, as insulating and filter material.

SALES

The combined output of all silica materials considered in this report increased markedly in 1923 as compared with 1922. The sales of quartz from pegmatite dikes, from veins, and from quartzite increased 93 per cent, of ground sand and sandstone 53 per cent, and of diatomaceous earth 47 per cent, but those of tripoli decreased 10 per cent.

The value reported for crude quartz in 1923 ranged from $1.52 to $6 a ton and averaged $4.71; the values of ground quartz ranged from $10 to $39.12 a short ton, and averaged $19.70. Production was reported from Arizona, California, Connecticut, Maryland, Nevada, New Hampshire, New York, North Carolina, Utah, Washington, and Wisconsin. Illinois, New Jersey, Pennsylvania, and West Virginia were the principal sources of ground sandstone, the value of which was considerably less than for ground quartz, namely, from $5 to $9 a ton. The average value of all ground sandstone sold was $6.71.

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[2] Published in Chem. and Met. Eng., May 5, 1924, pp. 715–717; reviewed in detail in Cement, Mill, and Quarry, May 20, 1924, pp. 33–36.

Silica sold by producers for pottery, paints, fillers, polishers, abrasives, and other uses in the United States, 1921–1923

Material	1921		1922		1923	
	Short tons	Value	Short tons	Value	Short tons	Value
Quartz (vein quartz, pegmatite, and quartzite)	11, 252	$84, 957	10, 653	$101, 347	20, 601	$193, 630
Sand and sandstone [a]	105, 887	802, 450	163, 295	1, 061, 057	249, 467	1, 672, 961
Tripoli (ground and otherwise prepared)	12, 340	213, 013	30, 205	316, 728	27, 082	382, 757
Diatomaceous earth	[b] 55, 134	[b] 682, 616	44, 761	386, 669	65, 833	699, 406
	184, 613	1, 783, 036	248, 914	1, 865, 801	362, 983	2, 948, 754

[a] Includes only finely ground material. Figures probably incomplete.
[b] Partly estimated.

Of the quartz sold in 1923, 6,442 tons, valued at $126,907, was ground.

IMPORTS

The Bureau of Foreign and Domestic Commerce records imports of "flint, flints, and flint stones, unground," from several countries. These imports are partly flint pebbles for use in grinding mills and partly material for uses such as are listed in this report. The figures can not be accurately separated.

Value of pebbles and flint imported for consumption in the United States, 1918–1923

1918	$127, 808	1921	$116, 157
1919	250, 096	1922	145, 805
1920	338, 630	1923	130, 974

PHOSPHATE ROCK

By George Rogers Mansfield[1]

INTRODUCTION

The phosphate-rock mining industry is slowly recovering from the uncertainty and depression that have marked its course for the last few years. As summarized by James A. Barr,[2] the first half of 1923 was very prosperous for the phosphate mining and fertilizer industry as a whole, but in the second half the industry shared in the general business depression. At the end of the year conditions were improving and prospects for 1924 were much better.

The continued drop in prices of farm products hurt the fall fertilizer trade, and the uncertain foreign situation as regards both markets and exchange combined to curtail the production of phosphate rock. Nevertheless, except for 1920, which was an unusually good year, sales of phosphate rock in the United States were better than at any other time since the war, and the same may be said for exports.

Efforts are now being made to induce farmers throughout the country to produce larger and better crops per acre rather than to enlarge their acreage. It seems certain, therefore, that the fertilizer industry and the phosphate-rock industry, on which it depends, must consistently advance.

PHOSPHATE ROCK SOLD

The sales of phosphate rock in the United States in 1923 compared with sales in 1922 increased 24 per cent in quantity and 10 per cent in value. Except for those in 1920 and 1913 they were higher than those of any preceding year. The value of the rock sold in 1923, however, was exceeded by that sold in 1911–1913 and 1919–1921.

Phosphate rock, mined in the United States, sold in 1918–1923

Year	Long tons	Value	Year	Long tons	Value
1918	2, 490, 760	$8, 214, 463	1921	2, 064, 025	$12, 270, 070
1919	2, 271, 983	11, 591, 268	1922	2, 417, 883	10, 482, 846
1920	4, 103, 982	25, 079, 572	1923	3, 006, 706	11, 576, 049

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[1] The statistical data in this chapter, except those showing imports and exports, were prepared by Miss Katrine W. Cottrell, of the United States Geological Survey, and the tables of imports and exports were compiled from the records of the Bureau of Foreign and Domestic Commerce by J. A. Dorsey, also of the Geological Survey. Miss Leona Boardman, of the Survey, has assisted in the preparation of parts of the manuscript, especially the list of patents and the bibliography.

[2] Rock Products, Dec. 29, 1923, p. 73.

In this report the unit of quantity used in referring to phosphate rock is the long ton of 2,240 pounds, except as otherwise specified. The value of domestic material means the selling value f. o. b. mines, so far as that can be determined from the returns submitted by the respective companies. Some of the companies, however, ship their rock to drying plants before selling, and others sell the rock f. o. b. foreign ports. Thus the figures given by these companies probably include an undetermined charge for transportation and are therefore somewhat higher than the value at the mine.

The sales of raw phosphate for direct application to the soil reached a maximum in 1919, as shown below. In 1921 there was a sharp break in this business, and, although there was a slight recovery in 1922, the decline continued in 1923, when the sales of raw phosphate for this purpose amounted to only 13 per cent of the sales for 1919. The rock thus sold in 1923 came from five producers. Approximately two-thirds of it came from Tennessee and one-third from Idaho; a small quantity came from Florida.

Raw phosphate rock sold for direct application to the soil, 1918–1923, in long tons

1918	45, 294	1921	13, 503
1919	79, 189	1922	16, 029
1920	72, 801	1923	10, 548

The quantity of phosphate rock sold in 1923 to blast furnaces was 26,531 tons. This quantity, which was furnished by eight companies in Tennessee and by one company each in Florida and Idaho, was 23 per cent less than the 34,481 tons sold for this purpose in 1922.

The manufacture of phosphorus annually requires a certain amount of raw phosphate rock. The amount sold for such use in 1923 was 214,691 tons, an increase of 84 per cent over the 116,386 tons thus sold in the previous year.

PHOSPHATE ROCK MINED

The quantity of rock mined in any year is not the same as the quantity sold, for the stock at the mines at the end of each year is variable. The quantity of rock mined in 1923 was greater than that mined in 1922 by 606,710 tons, or 26 per cent. As shown in the following table, the increase in the quantity of rock mined was general in both the eastern and the western fields. The largest increase in quantity of rock mined was in Florida, but the percentages of increase were higher in the Tennessee-Kentucky and western fields. The increase in the western field was due to the activity of the Anaconda Copper Mining Co. at Conda, near Soda Springs, Idaho, in mining rock to be shipped to its fertilizer factory at Anaconda, Mont. A further account of this company's operations is given on page 253.

Phosphate rock mined in the United States in 1922 and 1923, by States, in long tons

State	1922	1923	Per centage of increase in 1923
Florida	2,018,809	2,421,571	20
Tennessee and Kentucky	300,566	487,420	62
Western States	17,481	34,575	98
	2,336,856	2,943,566	26

STOCKS

Precise measurement of stocks of phosphate rock in the hands of producers is difficult. The estimates of stocks on December 31, 1923, reported by the producers amounted to 738,000 tons. By adding to the stocks reported at the end of 1922 the quantity mined in 1923 and subtracting from the sum the sales or shipments during the year an estimate of about 710,000 tons on hand December 31, 1923, is obtained.

PRODUCTION BY STATES

In 1923 there was an increase in the quantity of phosphate rock sold in all the usual phosphate-producing fields except South Carolina, from which no sales were reported. The value of the rock sold in 1923 was also greater than that for the preceding year, but the value per ton in the Florida and Tennessee fields, except for the blue rock, was less than in 1922. The value per ton of western rock, however, made a sharp advance over that for the preceding year.

Phosphate rock, mined in the United States, sold in 1922–23, by States

State	1922		1923	
	Long tons	Value	Long tons	Value
Florida:				
Hard rock	188,084	$1,308,201	199,516	$1,071,675
Soft rock	446	3,500		
Land pebble	1,870,063	7,035,821	2,348,137	7,987,752
	2,058,593	8,347,522	2,547,653	9,059,427
South Carolina:				
Land rock	1,500	8,250		
Tennessee:				
Brown rock	[a] 344,231	2,055,579	[a] 427,799	2,335,262
Blue rock	9,078	51,803	919	5,647
	[a] 353,309	2,107,382	[a] 428,718	2,340,909
Western States [b]	4,481	19,692	30,335	175,713
Grand total	2,417,883	10,482,846	3,006,706	11,576,049

[a] Includes brown rock from Kentucky.

[b] 1922: Idaho; 1923, Idaho and Wyoming.

Florida.—Florida, the leading State in the production of phosphate rock, sold 85 per cent of all the phosphate rock sold in the United States in 1923. The quantity sold increased 24 per cent over the quantity for 1922, but the value increased only 9 per cent.

In the hard-rock field, which is concerned mainly with export trade, there was some revival of mining activity in the earlier part of the year. Sales increased 6 per cent over those for 1922. The value, however, decreased 18 per cent.

Sales of soft rock, which in 1922 had been reduced to 446 long tons, ceased altogether, or, at least, none were reported for 1923.

Land-pebble rock constituted 97 per cent of the entire Florida output. Conditions in the pebble field were much better than in the hard-rock field but were still below normal. The sales of pebble rock in 1923 showed an increase of 26 per cent in quantity and 14 per cent in value over those for 1922.

Florida phosphate rock sold in 1916–1923

Year	Hard rock			Soft rock		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1916	[a]47,087	[a]$295,755	$5.26	([a])	([a])	$9.76
1917	[a]18,608	[a]159,366	5.93	([a])	([a])	12.40
1918	62,052	377,075	6.08	8,331	$147,103	17.66
1919	285,467	2,452,563	8.59	14,498	196,318	13.54
1920	400,249	4,525,191	11.31	13,953	190,551	13.66
1921	175,774	1,806,671	10.28	4,419	20,153	4.56
1922	188,084	1,308,201	6.96	446	3,500	7.85
1923	199,516	1,071,675	5.37	----------	----------	----------

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1916	1,468,758	$3,874,410	$2.64	1,515,845	$4,170,165	$2.75
1917	2,003,991	5,305,127	2.65	2,022,599	5,464,493	2.70
1918	1,996,847	5,565,928	2.79	2,067,230	6,090,106	2.95
1919	1,360,235	5,149,048	3.79	1,660,200	7,797,929	4.70
1920	2,955,182	14,748,620	4.99	3,369,384	19,464,362	5.78
1921	1,599,835	8,604,818	5.38	1,780,028	10,431,642	5.86
1922	1,870,063	7,035,821	3.76	2,058,593	8,347,522	4.05
1923	2,348,137	7,987,752	3.40	2,547,653	9,059,427	3.56

[a] Soft rock included with hard rock.

Prices of pebble rock rise rapidly with increase in content of tricalcium phosphate (known in the trade as "B. P. L."—that is, bone phosphate of lime), as shown in the following table:[3]

Prices of pebble phosphate per long ton, f. o. b. Florida

76 to 77 per cent	$6.00	70 per cent	$3.80
75 per cent	5.50	68 per cent	3.40
74 to 75 per cent	5.25		

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[3] Eng. and Min. Jour.-Press, May 3, 1924, p. 748.

South Carolina.—No mining or sales of phosphate rock were reported from South Carolina in 1923. The sales for several preceding years had decreased from 60,823 tons in 1919 to 44,141 tons in 1920 and 1,500 tons in 1922, no sales being reported in 1921. The average values of the rock at the mines for the three years specified were $5.08, $8.32, and $5.50, respectively.

Tennessee and Kentucky.—The phosphate rock sold in Tennessee and Kentucky in 1923 increased 21 per cent in quantity and 11 per cent in value, though there was a decrease of 8 per cent in the average value per ton. The figures for Kentucky may not be shown separately, because there was but one operator. The blue rock decreased 90 per cent in quantity and 89 per cent in value, but its average value per ton increased 8 per cent.

Tennessee phosphate rock sold in 1916–1923[a]

Year	Brown rock [a]			Blue rock			Total [a]		
	Long tons	Value at mines		Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average		Total	Average
1916	364,108	$1,357,888	$3.73	47,682	$152,465	$3.20	411,790	$1,510,353	$3.67
1917	447,203	1,920,533	4.29	65,904	205,820	3.12	513,107	2,126,353	4.14
1918	[b] 374,535	[b] 1,917,546	5.12	([b])	([b])	([b])	374,535	1,917,546	5.12
1919	475,475	3,123,565	6.57	58,550	290,951	4.97	534,025	3,414,516	6.39
1920	556,177	4,425,761	7.96	78,671	518,234	6.59	634,848	4,943,995	7.79
1921	252,543	1,666,358	6.60	25,163	146,198	5.81	277,706	1,812,556	6.53
1922	344,231	2,055,579	5.97	9,078	51,803	5.71	353,309	2,107,382	5.96
1923	427,799	2,335,262	5.46	919	5,647	6.14	428,718	2,340,909	5.46

[a] Small quantity of brown rock from Kentucky included with Tennessee.
[b] Blue rock is included with brown rock.

Western States.—The quantity and value of the phosphate rock sold in the Western States in 1923 were greater than in any previous year except 1920. The increase in quantity over 1922 was 577 per cent and the increase in value 792 per cent. The average value per ton was 32 per cent greater than in 1922 and 6 per cent greater than in 1920, the banner year in sales. Three producers were active in Idaho and one in Wyoming.

Western States phosphate rock sold in 1916–1923

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1916	1,703	$5,350	$3.14	1920	55,609	$304,006	$5.47
1917	15,096	41,756	2.77	1921	6,291	25,872	4.11
1918	11,955	42,161	3.53	1922	4,481	19,692	4.39
1919	16,935	69,855	4.12	1923	30,335	175,713	5.79

ACID PHOSPHATE PRODUCED IN THE UNITED STATES

According to information derived from the Bureau of the Census, Department of Commerce, 1,609,181 short tons of acid phosphates, containing 26,755,403 units (20 pounds) of available phosphoric acid, was produced during the second half of 1923, as compared with 1,758,039 short tons, containing 29,140,453 units, during the first half of the year, making for the year a total of 3,367,220 tons and 55,895,856 units, as compared with 2,788,207 tons and 46,612,850 units in 1922, an increase of 21 per cent.

The data are compiled from reports of 155 fertilizer establishments (not including dry mixing plants), 100 of which are in the southern district and 55 in the northern and western districts. Of the total 84 manufactured sulphuric acid (57 in the southern district and 27 in the northern and western). They are distributed by States as follows: Alabama, 13; Arkansas, 1; California, 2; Florida, 6; Georgia, 35; Illinois, 5; Indiana, 5; Louisiana, 4; Maryland, 10; Massachusetts, 2; Michigan, 1; Mississippi, 5; New Jersey, 4; New York, 1; North Carolina, 12; Ohio, 13; Pennsylvania, 3; South Carolina, 16; Tennessee, 7; Texas, 1; and Virginia, 9.[4]

IMPORTS OF PHOSPHATIC FERTILIZERS

The phosphatic fertilizers imported in 1923 included bone dust or animal carbon, bone ash, guano, crude phosphates, and basic slag. Each of these items showed a marked increase both in quantity and in value over the corresponding figures as far back as 1919, except that in 1920 the quantity of guano imported was nearly double and its value more than four times the respective figures for 1923, and in 1922 the value of crude phosphate was 4 per cent greater than in 1923.

Phosphatic fertilizers imported for consumption in the United States, 1919–1923

Fertilizer	1919		1920		1921		1922		1923	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Apatite	28	$825	142	$4, 904						
Bone dust or animal carbon, and bone ash, fit only for fertilizing	5, 948	182, 785	17, 793	908, 130	21, 516	$799, 591	32, 274	$860, 683	54, 143	$1, 691, 330
Guano	7, 017	255, 995	53, 790	4, 583, 313	1, 751	89, 527	13, 007	514, 325	28, 599	1, 104, 003
Phosphates, crude	34	457	63	2, 090	3, 535	43, 960	5, 890	95, 846	6, 725	92, 263
Slag, basic, ground or unground	46	2, 613					324	9, 762	361	6, 843

EXPORTS OF PHOSPHATE ROCK

The phosphate rock exported from the United States increased 15 per cent in quantity but decreased 1 per cent in value as compared with corresponding figures for 1922. The quantity was 23 per cent less than that for 1920 and 39 per cent less than the pre-war level (1,366,508 tons in 1913). The following table shows exports of phosphate rock in the last four years:

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[4] Bur. Census, The fertilizer industry, 1923 and 1922; Am. Fertilizer, Mar. 22, 1924, p. 31.

Phosphate rock exported from the United States, 1920–1923

Kind	1920		1921		1922		1923	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Phosphate rock, ground or unground, not acidulated:								
High-grade rock	344, 896	$4, 496, 457	182, 594	$2, 592, 541	202, 300	$2, 548, 587	194, 339	$2, 477, 501
Land pebble	693, 355	5, 593, 814	544, 425	4, 627, 875	512, 777	3, 269, 179	630, 565	3, 273, 006
All other	31, 461	479, 904	6, 293	99, 721	4, 217	40, 401	2, 647	21, 664
	1, 069, 712	10, 570, 175	733, 312	7, 320, 137	719, 294	5, 858, 167	827, 551	5, 772, 171

The destination of these exports is given in the following table, which shows that in 1923 Germany was the principal importer of high-grade rock and Belgium second. Germany's importations exceeded those of 1922 by 19 per cent and were 29 per cent greater than those of 1920. Belgium's importations, however, were only 5 per cent greater than in 1922 and were 40 per cent lower than in 1920, when they amounted to 55,645 tons.

Germany was also the principal importer of land pebble rock in 1923, followed by Spain, the Netherlands, and Belgium in the order named. Argentina, Finland, Greenland, Nicaragua, and Poland and Danzig joined the list of countries importing pebble rock, and Japan increased its imports of pebble rock by 73 per cent.

Small amounts of phosphate rock of other types were exported to several countries, among which Canada took the largest quantity.

Phosphate rock, ground or unground, not acidulated, exported from the United States, 1920–1923

High-grade rock

Country	1920		1921		1922		1923	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Belgium	55, 645	$690, 705	41, 513	$622, 695	32, 200	$483, 000	33, 650	$484, 950
Canada	2, 226	39, 442	6, 559	89, 262	3, 892	47, 045		
Denmark	58, 211	755, 655			4, 400	66, 000		
England	8, 306	124, 587	5, 042	78, 166			3, 543	28, 344
Finland					5, 650	74, 759		
Germany	104, 433	1, 407, 445	91, 880	1, 293, 893	113, 118	1, 335, 372	134, 586	1, 700, 187
Ireland	4, 600	69, 000						
Japan	4, 292	35, 076						
Netherlands	19, 522	266, 217	25, 100	328, 900	19, 991	258, 021	8, 140	77, 720
Norway	30, 978	428, 865	2, 500	38, 500	3, 200	48, 000		
Poland and Danzig			10, 000	141, 125	16, 349	183, 890	11, 420	171, 300
Spain	24, 480	312, 845					3, 000	15, 000
Sweden	32, 203	366, 620			3, 500	52, 500		
	344, 896	4, 496, 457	182, 594	2, 592, 541	202, 300	2, 548, 587	194, 339	2, 477, 501

Phosphate rock, ground or unground, not acidulated, exported from the United States, 1920–1923—Continued

Land pebble

Country	1920		1921		1922		1923	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Argentina							1,700	$7,650
Belgium	26,788	$216,934	45,160	$389,695	53,793	$309,183	61,434	336,874
British South Africa					3,000	17,250		
British West Indies	3,675	25,100						
Canada	3,854	30,494	146	2,676	9,895	75,028	10,031	54,468
Cuba	34,208	262,204	7,055	43,101	9,017	26,073	23,433	83,022
Denmark	18,406	192,648	9,062	103,791	54,605	429,984	57,425	330,323
England	154,975	1,277,278	52,924	422,495	36,983	270,300	55,093	299,757
Finland							2,000	14,000
France			20,380	124,323	27,149	185,121	31,466	180,509
Germany	9,129	96,855	79,004	884,135	51,578	283,918	133,948	701,883
Greenland							3,685	16,597
Honduras			3,596	16,182				
Ireland	61,097	395,797	36,713	289,779	18,716	141,504	20,612	94,303
Italy			7,352	73,520			20,915	96,540
Japan	42,516	322,428	20,743	113,799	8,201	31,804	14,225	50,081
Netherlands	70,477	505,612	69,416	558,912	86,218	498,516	67,702	337,371
Nicaragua							3,029	15,931
Norway	2,500	22,500						
Poland and Danzig							3,028	20,742
Portugal	8,305	55,381	24,545	260,315				
Scotland	77,487	574,305	17,438	138,085	13,715	104,014	17,904	77,468
Spain	139,066	1,226,670	133,462	1,006,634	122,443	788,027	92,326	492,936
Sweden	40,872	389,608	17.429	200,433	17,464	108,457	10,609	62,551
	693,355	5,593,814	544,425	4,627,875	512,777	3,269,179	630,565	3,273,006

All other phosphate rock

Country	1920		1921		1922		1923	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Canada	12,955	$187,780	4,931	$72,023	4,196	$38,281	1,600	$17,137
Cuba	8,134	160,824	1,197	23,635				
Germany	3,300	51,150						
Honduras			22	250				
Ireland	2,500	14,250			19	2,100		
Japan	1,382	12,737			2	20		
Mexico			110	2,975				
Newfoundland and Labrador	37	316	23	463			29	228
Oceania:								
Australia	3	30						
New Zealand	1	10						
Other British			1	17				
Other British West Indies	149	3,307	9	358			12	275
Spain	3,000	49,500						
Sweden							1,006	4,024
	31,461	479,904	6,293	99,721	4,217	40,401	2,647	21,664

The following table shows the relation between the total quantity of phosphate rock sold and the quantity exported during the last five years:

Phosphate rock sold in and exported from the United States, 1919–1923

Year	Sold (long tons)	Exported (long tons)	Proportion of exports to domestic sales (per cent)
1919	2, 271, 983	378, 731	17
1920	4, 103, 982	1, 069, 712	26
1921	2, 064, 025	733, 312	36
1922	2, 417, 883	719, 294	30
1923	3, 006, 706	827, 551	28

The following figures[5] show for a period of 34 years the growth and decline of Florida's export phosphate trade and also the comparative importance of hard rock and land pebble in this trade. It is noteworthy that in 1923 exports of land pebble advanced while those of hard rock declined.

Florida phosphate rock exported, 1890–1923, in long tons

Year	Hard rock	Land pebble	Year	Hard rock	Land pebble
1890	11, 206	----------	1907	591, 719	296, 918
1891	71, 682	----------	1908	631, 001	470, 270
1892	180, 013	----------	1909	478, 820	509, 341
1893	220, 216	----------	1910	461, 353	606, 110
1894	304, 079	----------	1911	449, 798	759, 510
1895	306, 046	----------	1912	470, 354	732, 651
1896	322, 871	----------	1913	476, 898	887, 398
1897	350, 277	----------	1914	287, 292	663, 839
1898	360, 505	----------	1915	42, 283	207, 551
1899	444, 675	----------	1916	31, 911	208, 288
1900	345, 577	86, 886	1917	9, 341	134, 943
1901	419, 349	113, 777	1918	62, 071	64, 732
1902	489, 520	144, 597	1919	241, 151	130, 974
1903	462, 903	152, 961	1920	344, 254	685, 766
1904	490, 366	219, 520	1921	174, 284	568, 415
1905	572, 311	238, 668	1922	198, 375	519, 954
1906	561, 040	214, 727	1923	191, 222	645, 036

[5] Am. Fertilizer, Feb. 23, 1924, pp. 30, 31.

Fertilizers exported from the United States, 1913–1923

	1915		1914		1915		1916		1917		1918	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Superphosphates (acid phosphates)	72, 747	$1, 666, 755	63, 554	$1, 311, 227	114, 205	$2, 785, 804	149, 286	$5, 010, 517	3, 844	$106, 778	6, 991	$257, 928
All other fertilizers									174, 592	5, 627, 304	74, 115	3, 359, 497

	1919		1920		1921		1922		1923	
Superphosphates (acid phosphates)	86, 790	2, 774, 856	80, 993	2, 949, 629	4, 278	96, 303	26, 781	372, 279	42, 156	541, 460
Prepared fertilizer mixtures	([a])	([a])	([a])	([a])	([a])	([a])	14, 416	690, 972	17, 997	832, 948
Nitrogenous fertilizer materials:										
Sulphate of ammonia							147, 331	8, 736, 611	150, 544	10, 874, 627
Calcium cyanamid (lime of nitrogen)							2, 556	26, 112	([a])	([a])
Other							1, 663	84, 274	13, 291	614, 814
All other fertilizers	188, 586	14, 567, 032	205, 666	15, 602, 658	55, 239	2, 602, 277	25, 462	898, 061	45, 073	1, 921, 972

[a] Not separately classified.

EXPORTS OF SUPERPHOSPHATES AND OTHER FERTILIZER MATERIALS

The export business in superphosphates (acid phosphates) and other fertilizers showed a marked increase in 1923, though it was still far below that for the years 1919 and 1920. The preceding table shows fertilizer exports since 1913 and exports of acid phosphates since 1917. It indicates an increasing export business in prepared fertilizer mixtures and nitrogenous fertilizer materials.

GOVERNMENTAL ACTIVITIES IN PHOSPHATE

Governmental activities relating to phosphate have in general been of two classes—the investigation and classification of public phosphate lands and the study of methods of conservation in mining and of concentration in treatment of phosphate rock. The activities of the first of these classes have been carried on by the Geological Survey, and those of the second by the Bureau of Soils.

GEOLOGICAL SURVEY

Phosphate investigations were carried on by the Geological Survey in 1923 in Idaho, Montana, and Florida.

Idaho.—The phosphate reserve in Idaho has been studied by members of the Survey intermittently since about 1906, and a number of papers relating to it have been published. These were listed in the bibliography given in Mineral Resources for 1922. A considerable area of the reserve still remains unexamined, and as these withdrawn lands can not be disposed of prior to their examination and classification, work of this sort is carried on as steadily as the resources and other obligations of the Survey will permit.

In 1923 a field party in charge of the writer spent three and a half months mapping and studying the Portneuf and Paradise Valley quadrangles, in southeastern Idaho, with special reference to their phosphate deposits. The work on the Portneuf quadrangle was completed, but only about half of the Paradise Valley quadrangle was covered. These two quadrangles lie between the Fort Hall Indian Reservation on the west and the Cranes Flat and Henry quadrangles on the east, all of which have been previously mapped. The work therefore served to connect areas in which the conditions were known and thus to extend the knowledge of the geologic conditions in this part of the phosphate reserve. The classification of the phosphate lands in the areas mapped has not yet been completed.

Montana.—In July, 1923, J. T. Pardee spent 10 days reviewing the Melrose phosphate field, Montana, which had been previously examined by the Survey in 1912 and 1913, with a view to completing an unfinished report on this area. This work was successfully accomplished, and the report, which is now in press, will appear as Bulletin 780–A.

Wyoming.—No field work was done in the Wyoming phosphate field in 1923, but a report on the Lander phosphate field by D. D. Condit, which had been unavoidably delayed in publication, was completed and is now in press. It will appear as Bulletin 764.

Florida.—On December 31, 1922, public lands withdrawn in the phosphate districts of Florida amounted to 119,523 acres in parcels ranging in size from less than 40 acres to as much as 400 acres and distributed in 295 townships in 31 counties, extending from Apalachicola River at the northwest as far south as Fort Myers. For several reasons the titles to some of these lands were obscure.

In the spring of 1923 the writer, with G. W. Holland, of the Geological Survey, traversed the region occupied by these lands to determine their general character and to study methods and costs of prospecting, with a view to the ultimate classification of the lands. It was soon found that the cost of prospecting the entire withdrawn area on any commercial basis would be so great that special appropriations from Congress would be required, such as are hardly justified under existing conditions. It was therefore determined to obtain all possible data regarding privately owned lands adjacent to Government tracts, in order to establish such a presumptive character for the Government land as the available data would permit. Such evidence would be sufficient to justify the Government in maintaining the mineral rights in many of these parcels of land, inasmuch as the burden of proof of their nonmineral character rests with the entryman. Where a definite classification was required for special reasons, recommendations for such work were made. In accordance with these recommendations prospecting was undertaken on ten 40-acre tracts in the spring of 1924, under the direction of J. T. Pardee, but the classification of these lands has not yet been completed.

Under the plan above outlined, Mr. Holland visited personally or communicated with all producers of record in the Florida fields and obtained from them many data in the form of maps, prospecting records, and reports. It is a pleasure to record the hearty cooperation of most of the producers interviewed. In this way useful data were obtained for 103 of the 295 townships.

Incidentally information of general interest regarding the annual capacity of producing companies in the pebble and hard-rock fields was obtained. This information, because of its confidential nature, can be used only in compiling totals for the districts as a whole. Thus the total annual estimated capacity reported by the major companies with their subsidiaries is nearly 5,000,000 tons in the pebble field and about 500,000 tons in the hard-rock field, making a total for both fields of 5,500,000 tons.

The production, however, lags far behind the capacity, for in 1923 the total quantity of phosphate mined in Florida (p. 241) amounted to 2,421,571 long tons, or less than half of the total annual capacity. The sales of phosphate rock (p. 242) in 1923 amounted to 199,516 long tons for the hard-rock field and 2,348,137 tons for the pebble field. Assuming that the sales were roughly proportional to production in the two fields, we find that production in the pebble field was 46 per cent of its capacity and in the hard-rock field 40 per cent. The material sold in the hard-rock field, however, must have been taken largely from stocks, for at the time of the writer's visit this field was practically idle, and during the remainder of the year little activity in it was reported.

From one of the most experienced operators in the pebble field Mr. Holland received estimates relating to phosphate rock remaining in the ground in the recognized pebble area. It was stated that the estimates were based on developments or prospecting and that for some tracts the estimates had been used in financial transactions by certain of the companies. Their total indicates that the pebble field contains a minimum of more than 288,000,000 long tons of minable phosphate, sufficient to permit continued mining at the present rate for more than 100 years. It is interesting to note that this estimate exceeds by 36 per cent the estimate for the entire State (212,000,000 tons) given in Mineral Resources for 1922, which was probably unduly low.

Mr. Holland was able by a study of available records in Washington and the local land office to establish the status of some of the doubtful lands, so that on May 24, 1924, the outstanding withdrawals had been reduced to about 84,842 acres. He has prepared a list of these withdrawn lands showing their location by township, range, and section, so that their position may readily be identified on any map of the State that shows public-land divisions. Copies of this list, which bears the serial number 17320, may be obtained by addressing the Director, United States Geological Survey, Washington, D. C.

BUREAU OF SOILS

For a number of years scientists of the Bureau of Soils have been conducting experiments on the volatilization of phosphoric acid in phosphate rock, with a view to reducing the cost of treatment under current methods. The Bureau has recently published a pamphlet[6] setting forth in some detail the nature and results of these experiments. The authors conclude as follows:

> The results of the tests so far conducted with the semicommercial equipment at Arlington Experimental Farm, Va., have demonstrated conclusively that it is feasible to drive off phosphoric acid practically completely from run-of-mine phosphates in large-scale operations by means of burning fuel. They have also shown that a furnace can be constructed which will withstand for a protracted period the combined effects of extremely siliceous slags and the high temperatures attained in this process, but before data can be obtained which will show conclusively the commercial feasibility of producing phosphoric acid by this process a number of the mechanical difficulties encountered must be remedied.
>
> During the tests so far conducted, however, with the semicommercial equipment, there were periods of from three to five hours when the furnace appeared to operate quite efficiently, and if the data taken at such times are considered indicative of normal working conditions, the volatilization method of producing phosphoric acid appears economically superior to the ordinary sulphuric acid method or to the electric-furnace process. Based on the data gathered between certain periods of actual operation the estimated cost of production by the fuel-furnace process is $36.31 per ton (or 36 cents per unit) of P_2O_5 in the form of 75 per cent H_3PO_4 and $30.98 per ton (or 31 cents per unit) of P_2O_5 in the form of double acid phosphate. These figures are from $8 to $13 below the most favorable one recorded for the production of a ton of P_2O_5 by the electric-furnace and sulphuric acid methods. Whether or not efficiencies can be obtained through a more extended run commensurate with those indicated during these short periods must yet be proven, but certain fundamental principles have been established and such progress has been made that it appears likely this general method of producing phosphoric acid will be commercially applied.

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[6] Waggaman, W. H., Easterwood, H. W., and Turley, T. B., Investigations of the manufacture of phosphoric acid by the volatilization process: U. S. Dept. Agr. Bull. 1179, 53 pp., 11 pls., 12 figs., December, 1923.

WORK BY STATE SURVEYS OR OFFICIAL ORGANIZATIONS

Arkansas.—The director of the Agricultural Experiment Station, Fayetteville, Ark., writes with regard to the availability of the phosphoric acid in phosphate rock as follows:

> We find that crops take up phosphoric acid readily in acid soils, and we find, too, that the application of lime tends to neutralize the acidity and reduces the amount of phosphoric acid the crop gets.[7]

Oklahoma.—Phosphate is reported by a member of the Oklahoma Geological Survey[8] from the red beds of Oklahoma and Texas. The phosphate is in the form of heavy dark-maroon nodules, some of which contain as much as 24.9 per cent of phosphorus pentoxide, equivalent to about 54.4 per cent of tricalcium phosphate. In the single analysis given iron and alumina are respectively 3.23 and 5.11 per cent and silica 16.8 per cent. The locality described is in Cotton County, in the SE. ¼ sec. 33, T. 4 S., R. 9 W. No estimate of quantity is given, but at the locality indicated it is evidently not large. Under present conditions the material would not be of commercial interest even if present in large quantity, but the occurrence is of general interest as suggestive of a possible supply of low-grade reserve material in a region not hitherto considered phosphate bearing.

Tennessee.—Richard W. Smith, assistant geologist, Tennessee Division of Geology, was engaged during the summer of 1923 in field work in the preparation of a detailed bulletin on the phosphate deposits of Tennessee. He was associated with R. S. Bassler, of the United States National Museum, in investigating the geology and stratigraphy of the Mount Pleasant district.[9]

PRIVATE ENTERPRISES

Florida.—The United States Export Chemical Corporation, of Tampa, Fla., announces that the erection of its proposed superphosphate plant near Tampa, at an estimated cost of $1,500,000, will soon begin and be pushed to completion. It is planned to develop 4,000 acres of phosphate lands. Land for the several units of the plant has been cleared, much grading done, pilings for temporary docks delivered, surveys for railroad spurs completed, and quantities of construction materials ordered, and it is expected that materials for the main office building, laboratory, and machine and blacksmith shops will be delivered soon.[10]

Tennessee.—It is reported[11] that the Non-Acid Phosphate Co. of Tennessee has been organized with a capital of $400,000 and has acquired from the Consolidated Phosphate Co. 700 acres or more of land in the Gordonsburg section. It is planned to manufacture nonacid fertilizer by the A. L. Kreiss process. Col. John W. Fry, of Columbia, Tenn., is president of the new company.

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[7] Rock Products, July 28, 1923, p. 25.

[8] Shead, A. C., Phosphate in the Permian red beds of Oklahoma and Texas: Chem. Age, July, 1923, pp. 319–320.

[9] Eng. and Min. Jour.-Press, Oct. 6, 1923, p. 599.

[10] Manufacturers Record, Feb. 14, 1924, p. 87.

[11] Rock Products, Nov. 17, 1923, p. 66; Manufacturers Record, Nov. 8, 1923, p. 73.

Western States.—The phosphate mines of the Anaconda Copper Mining Co.[12] are at Conda, Caribou County, Idaho, about 9 miles northeast of Soda Springs. The company owns some 3,400 acres of mineral claims and town site. The claims are in the Aspen Range, which rises over 1,000 feet above Bear River valley, itself about 6,000 feet in average altitude above sea level.

The phosphate-bearing formation is from 130 to nearly 200 feet thick, but only the lower 7 to 10 feet is of minable grade, the rest being low-grade phosphatic shale and limestone with some thin layers of high-grade phosphate. The phosphate rock is of oolitic texture, with some nodules half an inch or more in diameter, but usually the grains are not coarser than fine sand. The rock contains 32 to 35 per cent of phosphoric acid, 46 to 50 per cent of calcium oxide, 2 per cent of iron and alumina, and 6 per cent of insoluble material (chiefly silica). There are also varying small amounts of sodium and potassium oxides, fluorine, carbon dioxide, sulphur trioxide, and traces of magnesium, manganese, chromium, vanadium, and chlorine.

The rocks, which were originally horizontal marine sediments, are now tilted and folded so that on the company's property there are two anticlines and three or more pronounced outcrops.

The mines are opened through two adits about half a mile apart. The adits and drifts are of identical construction, heavily timbered and electrically lighted. Main underground and surface tracks are 36-inch gage, with 60-pound steel rails. Main haulage is done with two 16-ton General Electric storage-battery locomotives, capable of handling a 100-ton net load, and 10-ton side-dump cars. Drifts along the phosphate bed are first made with smaller headings and are operated by animal haulage and lighter equipment, but after having been driven for several hundred feet they are alined and enlarged to full size with heavy timber and 60-pound rails. Three-compartment raises 100 feet apart are run from the adit level to the top of the ore or surface. Intermediate levels are driven from the raises at 100-foot intervals. These drifts are small and mostly untimbered. With backs of 300 to 700 feet there may be as many as six of these intermediates.

Up to the present time the underground work has been almost entirely of a development nature, but stoping was to be started in the fall of 1923. Since the beginning of the work, about three years ago, nearly 3 miles of drifts, crosscuts, and raises have been driven.

Milling operations include crushing the rock to three-fourths inch size or smaller and drying. Storage capacity is provided for 4,000 tons of dried rock ready to ship.

The plant at the adit level consists of completely equipped shops, laboratory, refrigerating and cold-storage plant, and warehouse. Electric power is purchased from the Utah Power & Light Co. Water is supplied by three springs in the hills 2 miles to the southeast. Railroad facilities are available through a branch of the Union Pacific Railroad (Oregon Short Line) connecting with the main line near Soda Springs. The town of Conda, built by the company, is being laid out as a model town with modern houses for families, bunk house, dining and recreation halls, and school facilities.

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[12] The Anode, vol. 9, Nos. 9 and 10, Butte, Mont., September and October, 1923.

The fertilizer department of the company is at Anaconda, Mont., where sulphuric acid is available as a by-product from the smelting of Butte ores, the Idaho phosphate rock being shipped thither for treatment. Weighed amounts of phosphate rock are mixed with about equal weights of 60° Baumé sulphuric acid to produce phosphoric acid, which is concentrated and then itself mixed with raw phosphate rock to make treble superphosphate.

The first plant, operating on a semicommercial basis, had a daily capacity of about 50 tons of finished product. In 1923 the company expended about $550,000[13] in the construction of a new fertilizer plant, which has a daily capacity of 120 tons. The phosphate plant at Anaconda in 1923 produced 7,583 long tons of treble superphosphate averaging approximately 45 per cent of available phosphoric acid.

MISCELLANEOUS ACTIVITIES RELATING TO PHOSPHATE

METHODS OF PROSPECTING

COMMERCIAL PROSPECTING IN FLORIDA

In the hard-rock field of Florida the bedrock is so rough and the distribution of the phosphate-bearing matrix so irregular that detailed prospecting must be done before any commercial exploitation may be attempted. In usual practice holes are spaced not more than 50 feet apart, and where greater detail is needed the distance between holes is reduced to 25 feet or less. In preliminary work holes may be spaced at 100 to 200 foot intervals; then intermediate holes are placed as necessary. In this way the shape and size of a commercial body of ore are carefully outlined. In 50-foot spacing a 40-acre tract systematically tested would contain 26 lines of holes with 26 holes each, a total of 676 holes, or about 17 holes to the acre.

The overburden is usually removed by " cupping." The " cup " is a vertically slit iron cylinder about 1 foot long and 2 inches in diameter attached to drill rods or pipe, which may be used in 5-foot or other convenient lengths. When the phosphate is reached or the overburden is too tough or hard for the " cup " the hole is cased with 2-inch double-thick pipe, and a chisel bit with ball valve, mounted on a 1⅞-inch pipe, is introduced. Drilling may be done either by man power, with a simple tripod and pulley, or by a power drill. The thickness of the phosphate matrix is determined together with the amount and quality of the washed and dried phosphate rock. On this basis the tonnage is computed for the area examined.

According to experienced operators a hard-rock plant would ordinarily cost about $100,000, and the minimum quantity of rock in sight for such a plant should be 50,000 tons, though a favorably located and shaped body of ore containing as little as 15,000 tons might be worked with a smaller plant. A small body of ore adjacent to an operating plant might be worked at profit, whereas by itself it would not be profitable.

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[13] Anaconda Copper Mining Co. Rept., Dec. 31, 1923.

In prospecting of this sort much barren ground must be tested in the course of locating and testing a commercially valuable body of rock. The cost of such work averages \$300 or more to the acre.

In the pebble field the phosphate matrix, though variable in quality and thickness, is much more regular than that of the hard-rock field, and fewer holes are needed. In commercial practice 16 holes are ordinarily sufficient to test a 40-acre tract. The method of prospecting is slightly different from that used in the hard-rock field. The whole operation is done with a modified form of posthole auger 4 inches in diameter, and 4½-inch casing is sunk at the same pace as the auger. The phosphate matrix removed from the auger is weighed after the water has been allowed to drain away, then washed over a standard screen, and the phosphate is dried over a fire and weighed. From the thickness of the matrix, the weight of the phosphate rock recovered, and the percentage of phosphate to matrix the tonnage of phosphate rock in the tract is computed according to a formula such as the following, which is used by one of the larger companies: Area (square feet) × thickness of matrix (feet) × weight per cubic foot (pounds) × percentage of rock in matrix ÷ 2,240. The grade of the available rock is determined by analysis. A sample prospecting summary for a 40-acre tract shows the total area, the minable area, the total minable tonnage and the average per acre, the average depth of the deposit, the average percentage in matrix, the average tricalcium phosphate, the average iron and alumina, and the average overburden per acre and per ton. The cost of such prospecting work was stated by one company to have averaged \$8 an acre for a tract of 2,000 acres.

Pebble-phosphate plants operate on a larger scale than hard-rock plants and require a far larger tonnage of minable rock. For example, a plant with an annual capacity of 100,000 tons a year is said to cost about \$500,000 to build. Depreciation, as in the hard-rock field, is heavy. For such a plant probably as much as 4,000,000 tons of rock should be in sight.

In both the hard-rock and pebble fields the depth of the overburden is of much less consequence in mining operations than formerly, though it must always impose limits upon exploitation. Whereas 10 to 15 feet of overburden was once considered excessive, and later intermediate limits were set, prospecting in the hard-rock field is now continued to a depth of 50 feet and in the pebble field to as much as 55 or 60 feet.

In the pebble field land is sold at a price per ton of rock in the ground. In May, 1923, the writer was informed that land containing 2,000 tons of phosphate to the acre would be considered minable under favorable conditions. An average overburden of 7 to 8 cubic yards to the ton of rock for the whole area would be the limit for ordinary-grade rock. One tract was sold in which the overburden averaged 8½ cubic yards, and for another in which the rock was of high grade 10 cubic yards was the limit set. The price per ton of rock in the ground was said to have ranged from 3½ to 15 cents. A sale carries title to the land.

PROSPECTING BY THE GOVERNMENT

Florida.—Prospecting by the Government on public phosphate lands in Florida has been undertaken at different times and places and has been the subject of criticism by local prospectors and operators who have pointed out its inadequacy in a commercial sense. It should be remembered, however, that the viewpoints of the Government and of local operators are not the same. The operators are interested in procuring quick returns on their investments and are therefore controlled by present commercial conditions. The Government, though interested in present conditions, is more concerned with the conservation and use of its resources in the future, when conditions may be very different from those of to-day. It is not, therefore, imperative that the Government should prospect and classify its lands in accordance with present commercial standards, although so far as available funds permit, it is desirable that the work should follow standard practice. Thus current work in Florida has been done in the usual way, though on a much smaller scale than commercial work.

Western States.—Owing to its mode of occurrence the western phosphate does not require the elaborate and expensive type of prospecting that is customary in Florida. The workable beds are so regular and so persistent in quality that samples need not be taken at such short intervals. The field is so slightly developed that no standard practice has been evolved. The method of laying out drifts and stopes in the different mines permits sampling at any desired interval.

Preliminary prospecting has consisted largely in tracing the phosphate outcrop and trenching it here and there by open cuts or in driving adits or tunnels to intercept the bed at favorable places. Whether sampled in mines or in open cuts the phosphate beds in any particular district have shown a surprising uniformity in grade.

Classification work by Government parties has included the mapping of the phosphate outcrop by instrumental methods and the sampling of the beds at all available places. Samples have been taken in mines, adits, or open cuts. Where there were no openings trenches have been dug by plow and scraper, if facilities for this work were to be had, or by the survey parties themselves with pick and shovel. Estimates of tonnage are based on the geologic structure as determined by field work and on the thickness and character of the phosphate beds as indicated by the measurements and samples obtained.

SIMPLIFIED PROCESS OF MAKING DOUBLE SUPERPHOSPHATE[14]

Several of the usual steps in manufacturing double superphosphate are avoided in a process proposed by Herbert H. Meyers, of Pittsburgh, Pa., in patent 1475959, granted December 4, 1923, and assigned to the Armour Fertilizer Works. In outline the old process consists of the following steps:

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[14] Am. Fertilizer, vol. 60, No. 1, p. 40, Jan. 12, 1924.

1. Preparation of dilute H_3PO_4.
2. Concentration of the H_3PO_4.
3. Mixing acid and rock.
4. Emptying the den.
5. Drying the double superphosphate.
6. Disintegrating the product.

In contrast with this is Mr. Meyer's method, which involves only four steps:

1. Preparation of dilute H_3PO_4.
2. Mixing acid and rock to form a slurry.
3. Heating the slurry to accelerate simultaneously the chemical reaction and dry the double superphosphate to a solid product.
4. Disintegrating the product.

BASIC SLAG AS FERTILIZER[15]

In Great Britain and on the European continent great quantities of basic slag, otherwise known as Thomas slag, are used for phosphatic fertilizers. Similar material would doubtless find more extended use in the United States were it not for the relatively low phosphorus content of American iron ores and the abundance of readily accessible high-grade natural phosphate rock.

As the name suggests, the slag is a by-product of the steel industry and contains the phosphorus that has been abstracted from the iron ores during the furnacing process. It is this feature which gives the slag value as a fertilizer. Basic slags may be obtained from either Bessemer or open-hearth furnaces, but the product of the Bessemer furnace contains more phosphorus and is therefore a higher-grade fertilizer.

As basic slag is not readily soluble in water the distribution of this material in the soil and its effectiveness as a fertilizer are necessarily dependent upon the degree of fineness to which it is ground. On account of its hardness and also because of the metal it contains, machinery of the type usually employed for grinding phosphate rock is not adapted for pulverizing slag. Ball or tube mills are therefore used, and a product 90 per cent of which will pass a 100-mesh screen is thus obtained.

Three distinct furnace products are now being sold in England under the name basic slag for use in agriculture—high-grade basic Bessemer slag containing 20 per cent of phosphoric acid (85 per cent "citrate soluble"[16]), open-hearth basic slag containing 7 to 14 per cent of phosphoric acid (85 per cent "citrate soluble"), and open-hearth basic slag containing 7 to 10 per cent of phosphoric acid (20 per cent "citrate soluble").

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[15] Abstracted from Waggamann, W. H., and Easterwood, H. W., Chem. and Met. Eng., Nov. 12, 1923, p. 873.

[16] "Citrate soluble" phosphoric acid represents that portion of phosphatic fertilizer materials that is not soluble in water but slowly soluble and available for plant food under conditions generally existing in soils. In common practice its percentage is obtained as follows: A 2-gram sample is put into a 9-centimeter filter and washed with successive portions of water until the filtrate amounts to 250 cubic centimeters of water, and the phosphoric acid is then determined in this wash water in the usual way as "water-soluble phosphoric acid." The insoluble residue is treated in 100 cubic centimeters of neutral ammonium citrate solution at exactly 65° C. for half an hour. The solution is filtered, the residue dissolved in hydrochloric and nitric acids, and the phosphoric acid determined. The phosphoric acid found in the last reaction, together with the water-soluble phosphoric acid first obtained, is subtracted from the total phosphoric acid contained in the original sample. The difference represents the citrate-soluble phosphoric acid. For further details see "Methods of analysis of Association of Official Agricultural Chemists, Nov. 1, 1921."

Basic slag produced in European countries, 1913 and 1921, in metric tons

	1913	1921		1913	1921
Austria-Hungary	50,800		Great Britain	730,000	210,000
Belgium	655,000	325,000	Russia	49,000	
Germany	2,250,000	953,000	Sweden	18,354	

A NEW EUROPEAN CONCENTRATED FERTILIZER[17]

A new concentrated fertilizer called "phosphazote," containing nitrogen and phosphorus, is being manufactured in Switzerland and France, and licenses have been obtained for its manufacture in other countries. The nitrogen is furnished by calcic cyanamid. Tricalcic phosphates are changed into dicalcic or monocalcic phosphates, and cyanamid is transformed into urea and its derivatives.

Phosphazote has proved to be an excellent fertilizer, acting with extreme rapidity. It has no dangerous toxicity, even in quantities five times greater than the normal application. Its appearance is favorable, it is but slightly hygroscopic, and it is easy to handle. The nitrogen and the phosphoric acid seem to be in a form more readily assimilable than any others that have been found up to the present time. The greater part of the nitrogen is in an organic form, soluble in water.

RECENT PATENTS[18]

The following patents on processes for making phosphate rock available in fertilizers have been issued recently. Copies of the United States patents may be purchased for 10 cents each from the Commissioner of Patents, Washington, D. C., from whom also information regarding foreign patents may be obtained.

UNITED STATES

1434749, November 7, 1922, H. Plausen. Insoluble phosphate material, such as Thomas phosphate meal, is subjected to thorough mechanical disintegration together with humic acid containing material—for example, bituminous brown coal and caustic alkali.

1437456, December 5, 1922, E. C. Soper. Phosphate rock is mixed with $NaHSO_4$, 22½ per cent, and ground corn cobs or sawdust, 7½ per cent, and with such a limited amount of H_2O as to leave the mixture in pulverulent condition, and it is then calcined at a temperature of about 1,320°–1,430° to form a fertilizer.

1439054, December 19, 1922, E. H. Armstrong. Acid phosphate is cured by treatment with a rising current of air in vertical towers or chambers through which the acid phosphate descends, followed by similar treatment with unheated air. The mass is subjected to centrifugal action during its downward movements.

1445167, February 13, 1923, H. Plausen. Slag phosphate is ground and then subjected to intensive mechanical disintegration in the presence of a large amount of H_2O acidulated with H_2SO_4 or other acid, with or without heating or use of protective colloids.

1447544, March 6, 1923, W. Glaeser. Sodium phosphate is formed by treating phosphate rock with a solution containing niter cake and NaCl, heated to about 500°.

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[17] Abstracted from Am. Fertilizer, Apr. 7, 1923, pp. 29–31.

[18] From Chem. Abstracts.

1453571, May 1, 1923, E. P. Stevenson. Pebble phosphate initially containing tricalcium phosphate, $CaCO_3$, moisture, and organic materials is heated alone to a temperature of about 1,000°–1,100° to decompose the $CaCO_3$ and cause a substantially complete conversion of the resulting free lime into phosphate. The product is adapted for use as a fertilizer.

1459124, June 19, 1923, H. A. Webster. Phosphoric rock is powdered, suspended in H_2O, and treated with H_2SO_4, then further diluted with H_2O and heated to above 60° (preferably about 85°).

1461077, July 10, 1923, H. A. Webster. Powdered phosphate rock is introduced into a mixer simultaneously with H_3PO_4 or a quantity of 52° Baumé H_2SO_4 less than that theoretically required to convert all the tricalcium phosphate into monocalcium phosphate, the powder and acid are mixed, and the free H_2O present is eliminated by aerating while hot to produce superphosphate.

1463959, August 7, 1923, B. G. Klugh. Phosphatic material, such as natural phosphate, is electrically smelted together with siliceous flux and carbon or other reducing material to produce phosphorus and carbon monoxide; these are treated with a restricted amount of air to oxidize the solution without appreciable oxidation of the carbon monoxide.

1468741, September 25, 1923, S. Peacock. $Ca_3(PO_4)_2$ is reacted upon with six molecular proportions of NaCl at a temperature of about 1,100° in order to form $POCl_3$ and Na_2O. The chloride formed is separated from the oxide and is treated with H_2O to form a mixture of HCl and H_3PO_4, and the latter is separately recovered.

1470968, October 16, 1923, S. D. Gooch. A calcium acid phosphate is prepared by subjecting phosphate rock or phosphatic clay in finely divided form to the direct action of P_2O_5 while the material is agitated.

1475959, December 4, 1923, H. H. Meyers. A slurry is formed by adding ground phosphate rock to dilute H_3PO_4 of a strength so low that complete reaction will not be effected without application of heat, and the mixture is heated to complete the reaction and dry the product.

1485406, March 4, 1924, H. H. Meyers. Phosphate rock is wet ground and then acidulated, heated, and dried to produce available phosphate.

1493099, May 6, 1924, C. Bramson. Phosphate rock is treated with H_2SO_4 and the soluble product separated and limed. An alkali sulphate such as Na_2SO_4 is added to the limed and unfiltered material to recover dicalcium phosphate from the monocalcium phosphate previously precipitated with iron, aluminum, and CaF_2 impurities.

1493100, May 6, 1924, C. Bramson. Addition to 1493099. An excess of lime is added to the washed waste product obtained in purifying crude H_3PO_4 from phosphate rock, and the product is dried and calcined to render it suitable for further treatment with H_2SO_4 to recover phosphate.

1495270, May 27, 1924, J. M. A. Stilleson. Available phosphate is prepared by treating a nonavailable phosphate with CO_2 and H_2O. A mixture of calcium phosphate and carbonated " lime nitrogen " may be similarly treated.

GREAT BRITAIN

184206, November 10, 1920, J. G. Williams. Mineral or precipitated $Ca_3(PO_4)_2$ or bone ash is mixed with a solution of sodium, potassium, or ammonium sulphate and the product treated with SO_2. The reaction products are $CaSO_4$ and a soluble phosphate corresponding to the sulphate used, a soluble sulphite being also formed. The formation of sulphite can be avoided if one of the three molecules of sulphate required for the reaction is replaced by one of H_2SO_4, and this may be accomplished, with Na_3PO_4, by the use of niter cake. No sulphite is formed when precipitated $CaHPO_4$ is treated, and in this case the SO_2 can be recovered by heating the filtered reaction liquid. Other acids readily volatile from hot solutions, such as HOAc or formic acid, or CO_2, or H_2S, may replace SO_2.

186223, April 9, 1921, Eisenwerk Ges. Maximilianshütte. Phosphoric compounds suitable for fertilizers are made soluble in citric acid and partly soluble in citrates by intimate grinding with about 1 to 1½ parts of sulphate, chloride, silicate, or nitrate of the alkali or alkali-earth metals, ammonia, or magnesium. Double salts of the alkali metals and magnesium also may be used.

191129, October 1, 1921, L. Adelantado. Phosphates are rendered assimilable by treatment with a neutral sulphate in the presence of H_2O and organic matter at temperatures of 60° to 130°. When the phosphate contains alkaline materials it is desirable to add a small quantity of H_2SO_4. The addition of small quantities of carbonates, if these are not naturally present, is advantageous, since they react with the added acid and so render the mass porous.

191642, February 1, 1922, H. G. C. Fairweather. H_3PO_4, $H_4P_2O_7$, and HPO_3 are obtained by treating phosphatic material, coke, silica, and iron in an electric furnace, oxidizing the liberated phosphorus in the furnace by admitting a regulated quantity of air, cooling the gases, and separating the acids by an electric precipitator or other means. When the gases are cooled to 70°–120° H_3PO_4 of 70 to 80 per cent strength is obtained, at 120°–210° H_3PO_4 of 80 to 97 per cent strength, at 210°–315° $H_4P_2O_7$, and at 315°–400° HPO_3. In each case the H_2O vapor is present in the gases cooled, being introduced in the oxidation air and as moisture in the charge, but additional H_2O may be introduced into the gases.

194208, May 25, 1922, Soc. anon. produits chimiques et engrais L. Bernard. A homogeneous mixture of a phosphate rock, blast-furnace slag, or feldspar is heated with by-products containing alkalies, such as residues from sugar mills or distilleries or wool grease. The residue containing alkalies may be employed as such or may be first calcined and ground. The mixture of the materials may be effected wet or dry, and the heating may be at 900° to 1,300°.

195655, June 28, 1922, Plauson's (parent company) (Ltd.). Phosphates, feldspar, and other raw materials are rendered colloidal for use as fertilizers by high-speed mechanical disintegration in the presence of a large quantity of H_2O and a soluble silicate such as water glass. A small quantity of free alkali or substances, such as carbonates or sulphides, having an alkaline reaction may also be present. Organic colloids, such as sulphite cellulose liquors, tanning agents, proteins, or gums, may be added with the water glass.

CANADA

226546, November 28, 1922, A. L. Kreiss. Phosphate rock is fed into a heated drier containing a solution of an alkali metal salt, and the mixture is dried.

228247, January 23, 1923, A. Kelly. Mineral phosphates are roasted to carbonize the organic matter; the latter is then removed by oxidation, and the roasted phosphate treated with an acid to produce H_3PO_4.

JAPAN

41223, December 22, 1921, Ryûichi Hayashi and the Taisei Kwagaku Kogyo Kabushiki Kaishi. Insoluble aluminum or iron phosphate ores are made soluble in citric acid or ammonium citrate. The mineral is put into a heated rotating or muffle furnace and heated for 30 minutes at 400° to 700° according to the condition. Then the contents are quickly cooled by blowing cold air or transporting them through a cooled tube and dissolved in citric acid or ammonium citrate, about 95 per cent being dissolved in the former and about 70 per cent in the latter. From these solutions ammonium, potassium, or calcium phosphates are easily isolated.

41224, December 22, 1921, Sen Kawamura. One hundred parts of powdered iron or aluminum phosphate ore are boiled and then evaporated to dryness with 11 parts of NaOH, 27 parts of $Ca(OH)_2$ and 100 to 150 parts of H_2O. The residue is powdered. By this treatment 77 per cent of the total phosphoric acid is dissolved in 2 per cent citric acid or ammonium citrate. As the product is not hygroscopic it is used for fertilizer and material for manufacture of other phosphates.

41377, January 11, 1922, Chuzo Imaizumi. When 100 parts of $Ca_3(PO_4)_2$ are mixed with 90 to 100 parts of H_2SO_4 of 55° Baumé $Ca(H_2PO_4)_2$ is produced in grains, and the remaining $Ca_3(PO_4)_2$ becomes a powder, The two salts can therefore be separated mechanically.

41977, March 14, 1922, Ryûichi Hayashi. Crushed ore of iron or aluminum phosphate is thoroughly mixed with about 20 per cent SiO_2 and 5 per cent powdered coal and heated at 500° to 700° in a furnace until the coal is burned away; 98 per cent of the phosphate in the product is soluble in ammonium citrate, and it remains soluble during storage.

42273, April 10, 1922, Yoshisaburô Kida. When $AlPO_4$ is decomposed into Na_3AlO_3 and Na_3PO_4 by the action of NaOH a large amount of alkali is consumed. If $FePO_4$ is mixed with $AlPO_4$ the consumption of NaOH is decreased to one-fourth to one-eighth, the product is a mixture of sodium-iron phosphates and sodium-aluminum phosphates.

42304, April 13, 1922, Sadao Yonemura and Kômei Hayashi. Addition to 41056. By heating a mixture of insoluble phosphates and organic and inorganic acids at 200° to 500° during 10 to 20 hours 90 per cent of the phosphates in the product is made soluble in citric acid or ammonium citrate. As acids to be added, $AcOH(COOH)_2$, H_2SO_4, HCl, or some acid salts are used in amounts of 33.5 to 35 parts as AcOH for 100 parts of P_2O_5 in the material.

43205, April 13, 1922, Kômei Hayashi. Insoluble phosphates are made soluble in ammonium citrate by heating with a mixture of 8 to 12 per cent H_2SO_4, HNO_3, or HCl and some salts such as SiO_2, kieselguhr, $(NH_4)_2SO_4$, K_2SO_4, etc., at 250° to 350°. The same change is produced by heating a mixture of insoluble phosphates and 5 to 8 per cent inorganic acid in a vacuum kettle.

42606, May 15, 1922, Yoshisaburô Kida. H_3PO_4 is produced from phosphate ore containing calcium, iron, or aluminum phosphates by treating with H_2SO_4 and extracting with Me_2CO or alcohol; $(NH_4)_3PO_4$ is precipitated by means of NH_3.

44239, December 19, 1922, Ryûichi Hayashi, Kômei Hayashi, Sadao Yonemura, Etsuzo Hosoi, and Kako Kuroki. A powdered mixture of 100 parts of aluminum or iron phosphate and 40 to 50 parts of $NaHSO_4$ is heated at 300° to 400° for 10 to 15 minutes in a reverberatory furnace until the color of the mixture is changed to yellow. The product is soluble in ammonium citrate.

NORWAY

38643, December 24, 1923, Edouard Krebs. A material containing P_2O_5, such as raw phosphate, apatite, etc., is treated with sulphite cellulose waste liquor. The mixture is evaporated and burned.

SWEDEN

51749, May 24, 1922, F. Liljenroth. The material is elutriated with phosphoric acid, and the liquid is separated from the insoluble residue. The H_3PO_4 is regenerated by precipitating the dissolved calcium with H_2SO_4 and is partly used for treating further quantities of the materials, while the excess is utilized as such or for the production of soluble phosphates.

54116, March 28, 1923, Aktiebolaget Alkaliverken. Raw phosphate is decomposed by a mixture of HCl and H_2SO_4 obtained by the action of Cl_2 (from alkali chloride electrolysis) upon aqueous SO_2.

WORLD'S PRODUCTION AND CONDITIONS

The United States, with a total production in 1923 of 3,054,964 metric tons, still retains its leadership among the phosphate-producing countries of the world and has succeeded in increasing its lead over Tunis, the second in the race. Nevertheless, the United States has not regained its supremacy with respect to the Mediterranean countries as a group, though its spurt in 1923 partly closed the gap between them.

Reports from France indicate that the African phosphate companies enjoyed a prosperous trade during 1923. The total exports of phosphate increased about 25 per cent over those of 1922, and prices have generally been satisfactory, in spite of the troubles with exchange. The Gafsa Co. (Tunis), a leading concern, shipped a weekly average of 28,770 tons throughout the year.[19]

With Algeria, Tunis, and Morocco all increasing their facilities and their production the Mediterranean countries seem destined to dominate the world's phosphate production unless the United States greatly increases its home demand.

According to Consul J. Lee Murphy,[20] European consumption of phosphate rock amounted to 4,355,000 tons in 1913 and had at that time shown an average increase of 240,000 tons a year during the preceding ten years. It is, however, still far from returning to the pre-war rate. From 3,193,000 tons in 1920 it fell to 2,823,000 tons in 1921, the loss being nearly equal to the falling off in the orders booked by the French factories. The phosphates received by the factories in 1922 amounted to 3,663,000 tons, and according to reliable information receipts for 1923 will aggregate about 4,140,000 tons. The deficit in consumption may be charged to the countries of central Europe, where depreciated exchanges have hampered business. The total consumption of these countries amounted to 1,275,000 tons in 1913 and to only 490,000 tons in 1923. These figures do not include the output of the central European mines, regarding which no statistics are available.

The fertilizer industry in the United States, though slowly recovering from a marked depression, must be regarded as still in its infancy. The day can not be far distant when American farmers will awaken to the fact that it is more economical and better business to reduce their acreage and, by the aid of fertilizers, increase their yield per acre than it is to continue the cultivation of large areas without fertilizers to obtain low and diminishing returns per acre. When the awakening comes the fertilizer industry will acquire new life, if it will consistently attempt to maintain low prices by the manufacture and sale of such types of concentrated fertilizers as will reduce transportation costs to a minimum. Phosphate production will then rise accordingly.

The following table, prepared by Miss W. I. Whiteside, of the United States Geological Survey, shows the world's production of phosphate rock for the last six years.

World's production of phosphate rock, 1918–1923, in metric tons

Country	1918	1919	1920	1921	1922	1923
Algeria	198, 539	271, 162	502, 614	398, 800	484, 304	467, 384
Angaur	([a])	30, 500	30, 500	30, 500	([a])	([a])
Australia:						
New South Wales	305	585	156	203	12	75
Queensland	----------	----------	----------	375	66	----------
South Australia	8, 204	6, 045	8, 893	5, 161	2, 759	453
Victoria	3, 438	2, 521	4, 290	1, 566	1, 114	488
Belgium	61, 700	90, 970	133, 040	55, 040	56, 840	23, 270
Canada [b]	127	22	----------	27	172	([a])
Chile [b]	----------	1, 500	1, 510	1, 200	500	([a])

[a] Data not yet available.
[b] Apatite.

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[19] Am. Fertilizer, vol. 60, No. 3, p. 35, Feb. 9, 1924.

[20] Manuscript report submitted to Department of Commerce May 20, 1924.

World's production of phosphate rock, 1918–1923, in metric tons—Continued

Country	1918	1919	1920	1921	1922	1923
Christmas Island (Straits Settlements)	54,227	69,722	70,692	87,893	100,947	([a])
Dutch West Indies: Curacao [c]		10,058	61,440	60,872	50,078	85,855
Egypt	31,147	29,365	114,813	122,024	60,220	25,370
France	([a])	103,869	124,929	111,984	146,526	([a])
Germany: [b]						
Bavaria		701	4,934	7,959	4,412	([a])
Prussia	1,822	1,283	1,927	925	([a])	([a])
India (British) [b]	5,182	508		353		([a])
Indo-China	([a])	7,050	13,200	9,900	7,600	9,847
Japan	192,271	122,868	97,340	32,001	12,320	33,107
Taiwan		5		18	([a])	([a])
Madagascar [c]					5,210	([a])
Makatea Island	40,000	40,000	32,000	60,000	71,350	74,230
Morocco, French	([a])	([a])	([a])	33,000	96,397	225,395
New Caledonia	7,925	5,729	11,421	5,000	5,142	12,932
New Zealand	5,080	4,064	5,427	6,108	3,178	([a])
Norway [b]	4,562	1,168		1,068		([a])
Ocean and Nauru islands	155,000	115,000	[d] 392,000	[e] 370,000	[e] 367,000	([a])
Portugal		300	1,775	1,054	([a])	([a])
Russia	([a])	([a])	([a])	([a])	3,634	([a])
Spain	43,303	25,035	42,896	38,064	6,492	5,397
Tunis	862,494	1,075,214	1,075,180	1,800,000	2,117,650	2,338,000
United States	2,530,737	2,308,448	4,169,851	2,097,153	2,456,690	3,054,964

[a] Data not yet available.
[b] Apatite.
[c] Exports.
[d] Eighteen months July, 1919, to December, 1920. Figures for calendar year 1920 not available.
[e] Fiscal year ending June 30 of the year stated.

NOTES ON FOREIGN PHOSPHATES

The following notes on foreign phosphates should be of interest to American producers.

EGYPT

Production and exports of phosphate in Egypt appear to have declined in the last few years. In 1922 the production amounted to 60,220 metric tons, which was barely half the production for the preceding year (122,024 metric tons). Exports in 1922 [21] amounted to only 18,000 tons, or approximately only 25 per cent of the exports of 1913; the average value per ton was $11.50. In 1922 Italy was the main purchaser, taking almost half of the total exports; the United Kingdom and Japan divided the remainder.

In January, 1924, exports amounted to 23,889 tons, as compared with 13,298 tons during December, 1923, and 2,123 tons during January, 1923, an increase of 10,591 tons and 21,766 tons, respectively.[22]

ALGERIA

One of the important sources of phosphates in northern Africa [23] is the property being worked under a concession from the French Algerian Government by the Compagnie des phosphates de Constantine. The company increased its capital in 1920, and the results have been most satisfactory. Profits in 1919 were 1,500,000 francs; they reached 5,000,000 francs in 1921 and over 6,000,000 francs in 1922. The output in 1919 was 209,770 metric tons; in 1921, 346,053 tons; in 1922, 401,757 tons. The output in 1923, it is stated, will show a notable increase over that of the year before. The organization foresees an annual output of 800,000 metric tons within the next two or three years. The work of modernizing the plant and equipment is being carried forward rapidly, probably in anticipation of the great development of the Moroccan fields, and many improvements in technical processes are being adopted. At present mechanical mining equipment is being used, thus reducing the labor costs and increasing output. Stocks are carried and handled by improved means at the Mediterranean shipping port of Bone, and loading facilities for steamers have been increased to 400 tons an hour. The narrow-gage line is being transformed to standard width "from Tebessa and Souk-Ahras" (probably to the shipping port). Engineers are reinforcing bridges and culverts that were not intended for carrying heavy loads. When these improvements are completed the movement from the mines to port will be greatly facilitated. There are already in service 200 automatic dump cars carrying 20 tons each.

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[21] Commerce Repts., July 2, 1923, p. 37.
[22] U. S. Dept. Commerce, Chem. Trade Bull. 24 E, May 3, 1924.
[23] Eng. and Min. Jour.-Press, vol. 117, No. 7, p. 300, Feb. 16, 1924.

The production of phosphate in Algeria in 1923 amounted to 467,384 tons, or approximately 3 per cent less than in 1922, when it was 484,304 tons. Stocks on hand at the end of 1923 were much less than at the end of 1922, because of the excess of shipments over production. The Algerian Bureau of Mines reported 262,263 tons on hand October 1 and 146,387 tons December 31, 1923. Exports in 1923 went to France, 165,697 metric tons; Italy, 106,300; Great Britain, 87,400; Spain, 86,500; Germany, 24,800; the Netherlands, 21,200; Belgium, 20,400; Sweden, 17,270; Denmark, 14,183.[24] The total exports, as shown by official figures, amounted to 551,369 metric tons. In the first quarter of 1924 production and shipments were about 35 and 49 per cent, respectively, greater than in the last quarter of 1923.[25]

TUNIS

Production in Tunis has been advancing steadily in the last few years. For 1923 it was 2,338,000 metric tons, as compared with 2,117,650 tons for 1922 and 1,800,000 tons for 1921. The leading producer extracted over 70 per cent of the total in 1923.

MOROCCO[26]

According to the report of the Office chérifien des phosphates for 1923 there has been a considerable increase in the Moroccan phosphate business. During the year 225,395 metric tons was extracted, most of it from the original deposits at Bou-Jniba. Transportation facilities from the mines to Casablanca were much improved during the year. Provisional service on the new standard-gage line has been established, and it is hoped that this will become regular during 1924. The bulk of the phosphate is still brought down by the narrow-gage line.

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[24] Am. Fertilizer, vol. 60, No. 9, p. 31, May 3, 1924.

[25] Commerce Repts., July 14, 1924, p. 80. Figures of production for 1923 from official sources.

[26] Russell, H. E. (United States consul, Casablanca, Morocco), Phosphate production and sale in French Morocco in 1923 (manuscript report, May 15, 1924).

Murphy, J. L. (United States consul, Tangier, Morocco), Development of the phosphate deposits in Morocco in 1923 (manuscript report, May 20, 1924).

Exports from Casablanca in 1923 amounted to 190,642 metric tons, of which 39,000 tons was loaded by hand before the installation of the mechanical apparatus. These shipments were carried by 138 ships to 40 different parts of the world, the largest consumers being Spain, 60,136 tons; the Netherlands, 51,504 tons; France, 24,875 tons; and the United Kingdom, 17,493 tons.[27]

The total sales, including 218 tons for domestic use in Morocco, amounted to 190,860 tons, as compared with 79,815 tons in 1922 and 8,232 tons in 1921. This quantity was distributed among 85 buyers, of whom 38 were classed as first-order purchasers taking only trial shipments. It would appear that former buyers were well satisfied with their earlier purchases. The average tenor of the deliveries was 76.145 per cent of tricalcium phosphate.

OTHER COUNTRIES

Australia.[28]—The use of fertilizers in Australia shows slow but steady progress, both natural and artificial manures being used. Of the total area under crop 71.62 per cent is manured. Fertilizers are now being generally used by the wheat growers in South Australia and Western Australia. The fertilizers are manufactured locally, the chief ingredients being phosphates obtained from Nauru, Gilbert, Ellice, and Christmas islands and nitrate of soda from Chile. There are about 11 plants manufacturing fertilizers in South Australia and about the same number in Western Australia. No statistics of the production of these factories are available.

Belgium.—According to a report by G. S. Messersmith, American consul at Antwerp, Belgium, dated January 12, 1924,[29] phosphate rock carrying from 74 to 82 per cent of phosphate of lime was then selling at Antwerp at about $8.50 a ton. On account of the depreciation of Belgian exchange purchases have been made from Tunis, Algeria, and Morocco, and Florida rock, though superior in quality, has not been in demand. The Tunisian phosphate rock imported analyzes about 58 to 63 per cent phosphate. Moroccan phosphate rock is reported as coming rapidly to the front because of its high phosphate content and its low price in French francs, and 5,000 tons of it was imported at Antwerp in 1923.

Complete figures for 1923 are not available, but 51,098,905 kilograms of crude phosphate was imported in 1922, of which 30,178,372 kilograms, or 59 per cent, was reexported. These figures give an idea of the requirements of the country in raw phosphate as differentiated from its trade in this material. Of the total imports in 1922 the United States supplied 13,236,990 kilograms, or 26 per cent, and the remainder came from Tunis, Algeria, and Morocco. In 1913, before the war, the total imports of crude phosphate amounted to 244,767,411 kilograms, of which the United States supplied 52 per cent, Algeria and Tunis together supplied 34 per cent, and the remainder came from a number of other countries.

Canada.—An interesting discovery of phosphate rock has been made near the shore of Françoise Lake, British Columbia, just south of the Grand Trunk Pacific Railway. An analysis of the rock made at the laboratory of the Department of Mines, Ottawa, for the department of colonization of the Canadian National Railway shows 32.41 per cent of phosphoric acid and 5.30 per cent of iron and alumina combined. As soon as weather conditions permit further explorations will be made to determine the extent of the deposit.[30]

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[27] Letter to Director U. S. Geol. Survey, dated Jan. 3, 1924, from Directeur Général, Office chérifien des phosphates, Rabat, Morocco.

[28] Dept. Commerce Chem. Trade Bull. 12 E, Feb. 8, 1924.

[29] Dept. Commerce Chem. Trade Bull. 13 E, Feb. 15, 1924.

China.[31]—It is reported that a very large deposit of apatite as a vein in crystalline schist, has been discovered near Haichow, Kiangsu, China. No definite plans for development have been made.

Czechoslovakia.[32]—It is reported that considerable quantities of American phosphate have recently been imported into Czechoslovakia for the manufacture of fertilizers, against severe competition from European producers.

France.—A new fertilizer is being offered to the farmers of France by the Compagnie de Saint-Gobain under the name "superam." It is manufactured by the neutralization of the residual phosphoric acidity of acid phosphate by means of ammonia gas. It is claimed that by using this gas at a concentration of 3 to 5 per cent and by a rigid control of the temperature of the reaction, the reversion of the phosphoric acid to an unavailable form is avoided. The new fertilizer is fine, dry, and friable. A typical analysis of superam shows a nitrogen content of 4.1 per cent, with 15.77 per cent of total phosphoric acid, of which 97 per cent is available and 76 per cent soluble in water.[33]

French Oceania.—The phosphate production of the colony of French Oceania, which is composed of the Society, Tuamotu, Marquesas, and scattered groups of islands, amounted to 60,000 tons in 1921. The phosphate rock as shipped is said by officers of the exploiting company to run about 80 per cent phosphate.[34] According to figures furnished by the Ministry of Colonies, Paris, the output of phosphate rock in Makatea Island was 71,350 metric tons in 1922 and 74,230 tons in 1923.

Germany.—German soil is in great need of phosphates. This need will continue to increase, and an appeal has been made to the German chemical industry to make available phosphates in the form of phosphoric acid at prices that will permit general use.[35]

As reported in a German chemical journal neutral phosphate is prepared by a process of digestion of phosphate rock or bone meal, or mixtures of both, with small amounts of sulphuric acid, whereby the carbonates and fluorides are decomposed and sulphate of lime is formed. The hydrofluoric acid liberated tends to decompose the silicates, while the carbon dioxide evolved produces a state of fine subdivision and large surface, making the phosphoric acid compound more available. The product is neutral and contains 20 to 25 per cent of phosphoric acid, which shows "considerable solubility" in citrate solutions.[36]

Nauru and Ocean islands.—An interesting and instructive series of articles on Nauru and Ocean islands is contributed by Harold B.

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[30] Am. Fertilizer, vol. 60, No. 8, p. 76, Apr. 19, 1924.
[31] Dept. Commerce Chem. Trade Bull. 3 A, Nov. 23, 1923.
[32] Dept. Commerce Chem. Trade Bull. 12 E, Feb. 8, 1924.
[33] Am. Fertilizer, Nov. 3, 1923, p. 74.
[34] Commerce Repts., Sept. 10, 1923.
[35] Am. Fertilizer, Dec. 1, 1923, p. 76.
[36] Am. Fertilizer, Dec. 1, 1923, p. 41.

Pope, commissioner for Australia, to the Industrial Australian and Mining Standard, beginning February 15, 1923.

The quantity of high-grade rock available on these two islands is stated to be not less than 100,000,000 tons. The quality of the phosphate is particularly high. Throughout their working history (over 22 years) cargoes shipped from both islands have averaged 85 to 88 per cent of tribasic phosphate of lime. Complete cargoes have been shipped averaging over 88 per cent. This tenor is believed to be without a parallel in phosphate mining.

Since the war the islands have been held under a mandate jointly by the United Kingdom, Australia, and New Zealand, and under the terms of the Nauru Island agreement act of 1919 each of these countries is entitled to an allotment of the mined product in the proportion of 42, 42, and 16 per cent, respectively, to be used for agriculture in the countries of allotment and not for export. The basis of the allotment is to be readjusted every five years in accordance with the requirements of each country. If in any one year one of the three countries does not require its full allotment, the other two countries are entitled, so far as their requirements for home consumption extend, to have the excess allotted between them in the proportions to which they are entitled by the act. Beginning July 1, 1920, the business has been vested in a board of three commissioners, one representing each Government.

The total annual output from Nauru and Ocean islands now approaches 400,000 tons, but even should it increase to 500,000 tons the supply will last for the next 200 years.

According to reports[37] by the three commissioners covering the second year's trading under the new arrangement, ending June 30, 1922, the phosphate shipped amounted to 361,205 (long) tons, compared with 364,251 tons for the first year. These shipments went to Australia, 47.20 per cent; New Zealand, 10.64 per cent; United Kingdom, 4.45 per cent; other countries, 37.71 per cent. All demands for the United Kingdom, Australia, and New Zealand were met at satisfactory prices, and the surplus output was disposed of to other countries at market rates.

Nigeria.—According to a recently published bulletin[38] phosphate deposits of considerable extent and of probable commercial value have been discovered in Abeokuta Province, Nigeria, near the town of Oshosun, on the Lagos-Kano Railway. The discovery was made by W. Russ in 1921 in the course of a preliminary survey of the southern section of the Western Railway. The country is very difficult to work in, and there are practically no natural sections. The extent of the deposits is somewhat uncertain, but areas thus far examined approximate a total of 10 square miles. In pits already opened the thickness of the deposits ranges from a few inches to more than 4 feet, and it is estimated that the tonnage thus far revealed would run into seven figures. The published analyses show a range from 25.14 to 69.86 per cent of tricalcium phosphate and a rather high content of iron and alumina. In a set of eight complete analyses of typical specimens ferric oxide ranged from 0.57 to 10.93 per cent and alumina from 4.92 to 30.5 per cent.

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[37] Am. Fertilizer, Sept. 8, 1923, p. 32.

[38] Russ, W., The phosphate deposits of Abeokuta Province; Nigeria Geol. Survey Bull. 7, 43 pp., 1924.

The phosphate beds are in marine sediments of Eocene age that range in altitude from about 50 to 300 feet and dip about 2° SE. Typically they are associated with a fine homogeneous clay containing abundant gypsum and aragonite, and they have yielded a rich fauna, though the accompanying beds are barren. The phosphate rock itself shows a variety of types, of which the chief are granular, nodular, fine vesicular, coarse vesicular, and compact. The beds are regarded as closely similar in origin and character to those of Algeria, Tunis, and Egypt, though there are some differences in age. It is thought that they may be only a fragment of richer and more extensive beds yet to be discovered.

Netherlands.[39]—The chief product of the Dutch fertilizer factories is superphosphate, and the industry is of special interest to the United States, because of the large amount of American phosphate rock which it consumes at present and may require in the future. Although the phosphate factories of the country have a total annual capacity of about 450,000 metric tons they have been able to find a market for only about two-thirds of this quantity.

Europe is suffering from overproduction, or perhaps it would be more correct to say, from underconsumption, which is due to the economic depression. The large fertilizer factories in France, Belgium, and Germany are struggling to find a market in other countries denied them in their own. Only one factory in the Netherlands reported the financial results of its operations in 1922 as satisfactory, and this was a cooperative concern with a most modern plant, so situated as to avoid high costs of transportation or distribution. Most Dutch factories and to a certain extent European factories generally are operated in connection with some other chemical manufacturing or similar business.

Peru.—W. N. Pearce, secretary to the commercial attaché at Lima, Peru, in a report dated February 11, 1924, states that according to a recent decree the sale of phosphate will hereafter be administered by the Compañía administradora del guano. This company will sell phosphate to agriculturists and industries at cost plus handling charges and 5 per cent commission. " At the end of each producing season any balance resulting will be applied to reduction of the price of phosphate to the national agricultural interests."[40]

Russia.—The German press[41] has been emphasizing the desirability of concluding an arrangement with Russia to open up her enormous phosphate resources and convert the raw material into superphosphate on the ground in chemical plants operated by Germany.

Estimates have been made that European Russia has 5,568,000,000 tons of phosphate reserves, of which 141,000,000 tons has a phosphorus content of over 24 per cent, 1,707,000,000 tons from 18 to 24 per cent, and 3,720,000,000 tons from 12 to 18 per cent. The most interesting occurrence is in the government of Viatka, along the upper stretches of the Kama, a tributary of the Volga. The phosphate layer here is 0.6 to 0.8 meter thick, contains 26 to 29 per cent of phosphorus, and yields 400 to 500 kilograms of phosphate rock to the square meter.

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[39] Commerce Repts., Oct. 1, 1923, p. 19.

[40] Dept. Commerce Chem. Trade Bull. 17 E, Mar. 14, 1924.

[41] Commerce Repts., Aug. 6, 1923.

A fertilizer factory[42] has been built in this district about 11 versts (7.26 miles) from Perm, on the trunk Perm railway and on the bank of Kama River. The finest Ural pyrites in the Republic are found in convenient proximity to this factory, and by September, 1916, a sulphuric acid factory had been built. The superphosphate factory was not completed till about five years afterward. This factory, together with some others working in the Volga and central Russian districts, is said to be only the beginning of a great superphosphate industry in the Russian Republic; nevertheless it is expected that they may produce enough to permit a reduction of 1,000,000 poods (36,070,000 pounds) in the imports of superphosphates. The total superphosphate produced in 1922, however, was only 396,000 poods. Poor transportation facilities have hindered the procurement of adequate supplies of raw material.

South Africa.[43]—Wheat and maize are the principal South African crops, and it is estimated that 90 per cent of the fertilizers consumed in the Union are used for these grains.

Imports in 1922 amounted to 14,037 tons of superphosphate, chiefly from Great Britain and Holland; 8,286 tons of phosphate rock, chiefly from the Pacific Islands and the United States; 21 tons of sodium nitrate, from Belgium; and 3 tons of ammonium sulphate, from Great Britain. The United States furnished 3,162 tons of phosphate rock in 1922, although not mentioned in the trade returns for the three preceding years, during which Egypt is credited with furnishing the largest share. No imports from Egypt were made, however, in 1922.

It is estimated that the potential capacity of the factories in South Africa is 400,000 tons of superphosphate and 20,000 tons of ammonium sulphate.

Spain.—There are three acid phosphate plants at Malaga, Spain, with an aggregate output of 60,000 tons a year. A large percentage of the phosphate rock comes from Florida, although some comes from the Algerian deposits. In addition to the local output about 10,000 tons of superphosphate was imported into Spain from other European countries in 1922.[44]

In 1921 the imports of natural phosphates at Malaga from the United States amounted to 21,036 tons. In 1922 they were reduced to 5,602 tons, and this decrease is accounted for by the failure of American phosphate shippers to quote prices c. i. f. Malaga and to grant sufficiently liberal time payments. All orders were consequently placed with Algerian shippers.[44]

A report from Consul Horace Remillard,[45] Huelva, states that the year 1924 may see a discontinuance of shipments of Florida phosphate rock to Huelva. A Spanish company has been experimenting with rock received from Casablanca, Morocco, and it is stated that the results obtained have equaled those derived from the American rock. If this is true and an 18 to 20 per cent grade of superphosphates can be procured, it is not unlikely that this trade will be lost to American exporters, for they may find it difficult to meet the prices quoted by the Moroccans, who have the advantage of cheaper freight rates. There continues to be a demand for a high-grade superphosphate, many farmers preferring it to inferior qualities at cheaper prices; consequently, in case the Casablanca rock should prove unsatisfactory there will probably be the usual annual shipment of Florida rock of about 3,000 to 3,500 long tons to Huelva.

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[42] Am. Fertilizer, Dec. 29, 1923.

[43] Dept. Commerce Chem. Trade Bull. 33 E, July 14, 1924.

[44] Commerce Repts., Dec. 17, 1923.

[45] Dept. Commerce Chem. Trade Bull. 15 E, Feb. 29, 1924.

Assistant Trade Commissioner O. S. Payne, Madrid, writing to the Bureau of Foreign and Domestic Commerce under date of February 15, 1923, says:

> A process is reported to have been perfected for the manufacture of superphosphates of high concentration from phosphates of weak concentration. Experiments carried on at Caceres produced superphosphates containing 20 to 30 per cent of water-soluble phosphoric acid from phosphate deposits that ordinarily have yielded but 8 to 9 per cent of phosphoric acid. Tests on an industrial scale are to be made soon, and if they bear out the results of the laboratory experiments several million tons of weak phosphates in the center of the Iberian Peninsula will be turned to the profit of Spanish industry and agriculture.

Tasmania.—It is reported that the Electrolytic Zinc Co. of Australia has decided to install at its works at Risdon, Tasmania, a superphosphate factory to utilize the sulphur now wasted during the roasting of its zinc ores. Phosphate rock from the Pacific islands and the acid recovered as a by-product of the zinc works will be combined to produce 25,000 tons of superphosphate.[46]

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LIME

By G. F. LOUGHLIN and A. T. COONS

GENERAL CONDITIONS

The sales of lime manufactured in the United States in 1923 were 12 per cent greater than those of 1922, which had shown an increase of 44 per cent over those of 1921, a year of depression in the building and chemical industries of the country. All the principal producing States except Maryland showed increases in production in 1923. The quantity of lime sold for construction work and for chemical use increased, but that sold for the liming of land decreased. The number of plants reporting operations was 63 less than in 1922. This decrease was principally in Pennsylvania, Virginia, Maryland, and West Virginia, where lime is burned by farmers or small operators for local consumption. Production of this type has been falling off for several years, on account of the cost of fuel and scarcity of labor. Ohio retained her position, established in 1922, as the leading State in the production of lime, and Pennsylvania ranked second. The growth of the industry in Ohio is due chiefly to the increased output of hydrated lime used for building. In Pennsylvania, which was prior to 1922 the leading State, there has been during the last few years a decided decrease in the output of lime manufactured for use in agriculture and insufficient increase in the sale of lime for chemical and structural uses to offset this loss. During 1923 many improvements were made at plants and kilns in order to reduce the cost of labor to a minimum and to increase efficiency. Wages were high throughout the year, and at times, especially in the summer, common labor was difficult to obtain. The cost of operation was generally higher than in 1922, although coal was more plentiful and somewhat cheaper. The average value, at the plants, of lime sold increased from $9.14 a ton in 1922 to $9.81 in 1923, although many reports showed prices about the same or lower than in 1922.

PRODUCTION

Lime sold by producers in the United States, 1921–1923

Year	Short tons	Value [a]		Number of plants in operation
		Total	Average	
1921	2,532,153	$24,895,370	$9.83	520
1922	3,639,617	33,255,039	9.14	530
1923	4,076,243	39,993,652	9.81	467
Percentage of increase or decrease in 1923	+12	+20	+7	−12

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[a] The value given represents the value of bulk lime f. o. b. at point of shipment and does not include cost of barrel or package.

Lime sold by producers in the United States, 1922 and 1923, by States.

State	1922			1923		
	Number of plants in operation	Short tons	Value	Number of plants in operation	Short tons	Value
Alabama	11	168, 135	$979, 331	12	193, 429	$1, 627, 539
Arizona	2	(a)	(a)	3	18, 764	264, 683
Arkansas	5	11, 951	115, 008	3	14, 941	136, 185
California	8	55, 161	683, 774	8	66, 703	869, 979
Colorado	4	(a)	(a)	3	(a)	(a)
Connecticut	6	52, 108	743, 742	6	59, 158	813, 254
Florida	3	(a)	(a)	2	(a)	(a)
Georgia	1	(a)	(a)	1	(a)	(a)
Hawaii	1	(a)	(a)	1	(a)	(a)
Idaho	2	(a)	(a)	2	(a)	(a)
Illinois	10	85, 425	860, 945	11	92, 633	978, 658
Indiana	8	113, 246	938, 645	7	126, 296	1, 151, 083
Iowa	2	(a)	(a)	2	(a)	(a)
Kentucky	3	1, 560	11, 062	1	(a)	(a)
Maine	4	127, 840	1, 757, 480	4	139, 781	1, 946, 486
Maryland	21	71, 261	554, 194	14	63, 858	553, 811
Massachusetts	10	164, 980	2, 510, 368	10	180, 720	2, 550, 575
Michigan	7	53, 635	484, 945	7	59, 629	612, 369
Minnesota	5	27, 670	307, 270	4	29, 805	339, 957
Missouri	16	203, 984	1, 953, 524	16	246, 326	2, 505, 785
Montana	2	(a)	(a)	2	(a)	(a)
Nevada	1	(a)	(a)	1	(a)	(a)
New Jersey	4	2, 392	20, 845	2	(a)	(a)
New Mexico	4	3, 587	38, 520	3	1, 859	19, 362
New York	16	96, 320	957, 079	15	100, 862	1, 037, 737
North Carolina	1	(a)	(a)	1	(a)	(a)
Ohio	29	752, 916	6, 495, 066	31	867, 982	8, 740, 688
Oklahoma	2	(a)	(a)	2	(a)	(a)
Oregon	2	(a)	(a)	1	(a)	(a)
Pennsylvania	177	719, 536	5, 581, 794	143	772, 839	6, 372, 732
Porto Rico	27	5, 822	67, 636	24	6, 167	71, 014
Rhode Island	1	(a)	(a)	1	(a)	(a)
South Dakota	3	3, 852	43, 990	2	(a)	(a)
Tennessee	15	126, 305	939, 039	16	131, 995	1, 028, 158
Texas	7	52, 552	524, 985	9	62, 822	606, 976
Utah	13	11, 082	147, 087	11	12, 228	152, 136
Vermont	9	44, 745	565, 498	10	58, 681	702, 588
Virginia	41	152, 436	1, 251, 683	33	182, 604	1, 490, 306
Washington	6	25, 447	355, 412	6	25, 895	359, 510
West Virginia	15	219, 146	1, 643, 055	11	241, 601	2, 029, 061
Wisconsin	24	189, 558	1, 589, 931	25	227, 549	2, 055, 646
Wyoming	2	(a)	(a)	1	(a)	(a)
Undistributed		96, 965	1, 133, 131		91, 116	977, 374
	530	3, 639, 617	33, 255, 039	467	4, 076, 243	39, 993, 652

[a] Included under "Undistributed."

Lime sold by producers in the United States, 1922 and 1923, by uses

Use	Percentage of total quantity	Short tons	Value	
			Total	Average
1922				
Agricultural	7. 5	272, 726	$2, 005, 082	$7. 35
Building	50. 7	1, 845, 208	18, 463, 825	10. 01
Chemical:				
Glass works	1. 7	62, 187	463, 628	7. 46
Metallurgy	5. 5	200, 799	1, 458, 553	7. 26
Paper mills	8. 5	310, 229	2, 683, 487	8. 65
Refractory lime (dead-burned dolomite)	9. 6	348, 838	2, 813, 946	8. 07
Sugar refineries	. 5	16, 393	197, 878	12. 07
Tanneries	1. 2	42, 978	420, 148	9. 78
Other uses [a]	13. 3	485, 441	4, 172, 420	8. 60
Total chemical	40. 3	1, 466, 865	12, 210, 060	8. 32
Sold to dealers (uses unknown)	1. 5	54, 818	576, 072	10. 51
	100. 0	3, 639, 617	33, 255, 039	9. 14
Hydrated lime (included in above totals)		1, 106, 063	9, 868, 980	8. 92

[a] Details of distribution shown in the following table.

Lime sold by producers in the United States, 1922 and 1923, by uses—Continued

Use	Percentage of total quantity	Short tons	Value	
			Total	Average
1923				
Agricultural	5.9	240,551	$1,825,519	$7.59
Building	52.3	2,131,533	22,521,638	10.57
Chemical:				
Glass works	1.9	78,942	676,291	8.57
Metallurgy	9.2	373,020	3,044,383	8.16
Paper mills	7.6	311,309	2,768,909	8.89
Refractory lime (dead-burned dolomite)	8.8	357,642	3,599,116	10.06
Sugar refineries	.3	13,044	164,039	12.58
Tanneries	1.3	53,906	523,994	9.72
Other uses [a]	12.7	516,296	4,869,763	9.43
Total chemical	41.8	1,704,159	15,646,495	9.18
	100.0	4,076,243	39,993,652	9.81
Hydrated lime (included in above totals)		1,225,928	12,229,598	9.98

[a] Details of distribution shown in following table.

Chemical lime sold by producers in the United States for "other uses," 1922 and 1923

Use	1922		1923	
	Short tons	Value	Short tons	Value
Alkalies	4,275	$33,823	16,719	$145,425
Water purification	87,432	802,383	92,406	905,401
Sanitation	2,048	16,480	-------	-------
Calcium carbide	(a)	(a)	5,513	51,709
Bleaching powder	20,979	202,308	28,202	287,509
Calcium acetate	13,500	121,788	12,833	127,401
Silica brick	11,707	95,772	13,993	117,376
Sand-lime and slag brick	28,612	256,280	14,854	139,945
Ammonia works	11,847	100,848	10,816	98,953
Lubricating-grease manufacture	3,975	40,655	6,256	68,601
Coal and water gas purification	1,303	14,665	11,889	71,477
Coke-oven by-products	6,370	51,305		
Gas-plant by-products	6,668	51,592		
Soap manufacture	19,613	140,135	18,186	123,222
Glue manufacture	4,946	43,066	10,484	97,977
Insecticides (spraying)	8,950	89,445	10,972	116,181
Varnish	(a)	(a)	1,155	9,994
Paint manufacture (including kalsomine)	2,503	23,234	4,674	45,293
Wood distillation	5,963	46,278	8,771	84,583
Sewage purification	2,073	17,931	1,473	12,464
Acetic acid	-------	-------	13,536	132,757
Neutralization of acids	-------	-------	2,374	39,180
Dairy products	246	2,701	388	4,242
Rubber manufacture	1,923	23,443	767	9,162
Correction of acidity of oils	934	12,216	1,020	10,300
Salt refining	1,278	11,734	968	8,959
Flour mills	225	3,234	659	9,041
Disinfectant	737	7,146	(a)	(a)
Undistributed [b]	12,810	124,610	14,419	180,989
Unspecified	224,524	1,839,348	212,969	1,971,622
	485,441	4,172,420	516,296	4,869,763

[a] Included under "Undistributed."

[b] Includes, in 1922, lime used in the manufacture of precipitated calcium carbonate, glycerin, dyes, oxygen, potash, candles, varnish, corn products, gelatin, buffing compounds, gypsum products, proprietary medicines, calcium carbide, explosives, basic magnesium carbonate, distillation and dehydration of alcohol, use in print mills, and for mixture with wood ashes; in 1923, lime used in the manufacture of nitrates, food products, buffing compounds, magnesia, pottery, textiles, dyes, oxygen, distillation and dehydration of alcohol, gelatin (edible), explosives, ice, corn products, disinfectants, candles, baking powder, and poultry food.

It is necessary to classify much material as "unspecified," because many of the manufacturers do not report the uses of the part of their lime which they sell for chemical purposes. It is known to be applied to several of the uses enumerated, but the figures given are the best available.

The above figures do not include a considerable amount of lime which is not a commercial product but is burned for use in manufacturing from stone either quarried or purchased by the manufacturer. This stone is reported to the Survey as raw limestone and is included in the statistics on stone. It is used principally by alkali works, carbide works, sugar refineries, and smelters.

Lime sold by producers in the United States in 1923, by States and uses

State	Building		Agricultural		Chemical uses												Total	
					Paper mills		Glass works		Sugar refineries		Tanneries		Metallurgy		Other chemical uses			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	50,606	$436,973			(a)	(a)					(a)	(a)	(a)	(a)	33,884	$279,591	193,429	$1,627,539
Arizona	13,572	191,375					630	$11,340	60	$810			774	$9,714	3,728	51,444	18,764	264,683
Arkansas	(a)	(a)	(a)	(a)	(a)	(a)									(a)	(a)	14,941	136,185
California	48,150	621,533	(a)	(a)	(a)	(a)			(a)	(a)	(a)	(a)	(a)	(a)	14,283	193,333	66,703	869,979
Colorado	(a)	(a)											(a)	(a)	(a)	(a)	(a)	(a)
Connecticut	(a)	(a)	(a)	(a)													59,158	813,254
Florida	(a)	(a)															(a)	(a)
Georgia	(a)	(a)															(a)	(a)
Hawaii	(a)	(a)							(a)	(a)							(a)	(a)
Idaho	(a)	(a)			(a)	(a)											(a)	(a)
Illinois	49,584	578,856			13,542	$124,718					(a)	(a)	(a)	(a)	20,797	193,724	92,633	978,658
Indiana	24,420	235,805	4,926	$42,889	29,180	255,108	4,600	37,034			2,109	$21,546	15,740	136,805	45,321	421,896	126,296	1,151,083
Iowa	(a)	(a)															(a)	(a)
Kentucky	(a)	(a)	(a)	(a)	(a)	(a)					(a)	(a)			(a)	(a)	(a)	(a)
Maine	83,229	1,433,349	7,678	38,256	(a)	(a)	(a)	(a)			(a)	(a)	(a)	(a)	(a)	(a)	139,781	1,946,486
Maryland	13,063	112,151	41,109	374,125	(a)	(a)					(a)	(a)	(a)	(a)	4,127	31,436	63,858	553,811
Massachusetts	130,758	2,053,886	3,960	14,042	32,154	332,061							445	4,829	13,403	145,757	180,720	2,550,575
Michigan	18,745	195,666	(a)	(a)	18,715	186,985			(a)	(a)	2,060	22,418			19,813	204,257	59,629	612,369
Minnesota	26,756	300,534											(a)	(a)	(a)	(a)	29,805	339,957
Missouri	94,516	939,865	1,014	10,978	13,668	125,147	278	3,293	751	8,521	4,200	44,953	13,024	124,070	118,875	1,248,958	246,326	2,505,785
Montana	(a)	(a)															(a)	(a)
Nevada	(a)	(a)															(a)	(a)
New Jersey			(a)	(a)													(a)	(a)
New Mexico	(a)	(a)													(a)	(a)	1,859	19,362
New York	26,035	259,539	3,668	25,559	20,011	210,880	(a)	(a)	(a)	(a)	3,596	46,544	11,667	130,209	35,642	362,277	100,862	1,037,737
North Carolina	(a)	(a)									(a)	(a)					(a)	(a)
Ohio	614,373	6,113,069	17,497	127,758	16,956	143,462	70,369	594,241	127	1,131	1,026	9,379	8,201	78,111	139,433	1,673,537	867,982	8,740,688
Oklahoma	(a)	(a)			(a)	(a)											(a)	(a)
Oregon	(a)	(a)															(a)	(a)
Pennsylvania	287,595	2,563,641	112,011	838,010	36,239	287,108	1,361	12,492	227	1,930	8,195	68,066	133,288	954,645	193,923	1,646,840	772,839	6,372,732
Porto Rico	445	3,806	1,466	9,493					4,256	57,715							6,167	71,014
Rhode Island	(a)	(a)	(a)	(a)							(a)	(a)			(a)	(a)	(a)	(a)
South Dakota	(a)	(a)											(a)	(a)	(a)	(a)	(a)	(a)
Tennessee	77,248	658,644	1,325	11,591	34,030	223,052			(a)	(a)	1,585	11,809	(a)	(a)	16,855	114,677	131,995	1,028,158
Texas	45,859	452,012	984	7,498	2,460	22,755	24	215	667	6,122	50	500	5,260	49,775	7,518	68,099	62,822	606,976
Utah	8,268	110,396											3,299	34,972	661	6,768	12,228	152,136

Vermont	28, 041	365, 696	1, 571	10, 784	11, 073	124, 909	--------	--------	666	8, 856	5, 752	68, 874	5, 016	51, 723	6, 562	71, 746	58, 681	702, 588
Virginia	84, 699	737, 857	21, 294	153, 152	14, 609	119, 097	--------	--------	600	4, 800	6, 478	50, 524	13, 664	107, 661	41, 260	317, 215	182, 604	1, 490, 306
Washington	18, 204	275, 887	(a)	(a)	(a)	(a)	--------	--------	(a)	(a)	--------	--------	(a)	(a)	1, 834	23, 818	25, 895	359, 510
West Virginia	26, 357	246, 175	16, 719	112, 374	(a)	(a)	(a)	(a)	--------	--------	(a)	(a)	47, 092	368, 025	138, 772	1, 193, 009	241, 601	2, 029, 061
Wisconsin	221, 377	1, 954, 571	(a)	(a)	3, 197	29, 380	--------	--------	--------	--------	(a)	(a)	--------	--------	2, 306	65, 148	227, 549	2, 055, 646
Wyoming	(a)	(a)	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	(a)	(a)
Undistributed	139, 633	1, 680, 352	5, 329	49, 010	65, 475	584, 247	1, 680	17, 676	5, 690	74, 154	18, 855	179, 381	115, 550	993, 844	14, 941	155, 349	91, 116	977, 374
	2, 131, 533	22, 521, 638	240, 551	1, 825, 519	311, 309	2, 768, 909	78, 942	676, 291	13, 044	164, 039	53, 906	523, 994	373, 020	3, 044, 383	873, 938	8, 468, 879	4, 076, 243	39, 993, 652

[a] Included under "Undistributed."

Building lime.—The output of lime for construction work, which had increased 49 per cent in 1922, showed an increase of 15.5 per cent in 1923. The demand for lime for building enterprises was moderately good during the first part of the year, but the general curtailment of construction that shortly followed and the rise in prices of some building materials and of labor had its effect on the total sales for the year. The leading States, Ohio, Pennsylvania, and Wisconsin, showed increases in output of 12, 23, and 27 per cent, respectively.

Chemical lime.—The output of chemical lime in 1923 showed an increase of 16 per cent over that of 1922, or practically the same increase as building lime. This followed an increase of 53 per cent in 1922, when the chemical industry was recovering from the industrial depression of 1921.

Agricultural lime.—The total sales of lime for agriculture decreased 12 per cent in 1923, and Virginia and West Virginia were the only important States to show increases. Pennsylvania, the principal producing State, showed a decrease of 19 per cent, and Ohio and Maryland also showed decreases. The decline in output is ascribed to the inability of the farmers to buy lime, the high cost of fuel and labor, and scarcity of common labor. Ground limestone for this purpose, which for several years increased in output as burned lime decreased, has also decreased since 1919, but in 1923 it increased 7 per cent. Sales of calcareous marl for agriculture increased 47 per cent, but sales of oyster-shell lime decreased 40 per cent.

Agricultural lime sold by producers in the United States, 1922–23, by kinds

Kind	Short tons		Value	
	Gross	Effective lime content	Total	Average
1922				
Lime from limestone:				
Quicklime	122,303	102,700	$750,188	$6.13
Hydrated	150,423	105,300	1,254,894	8.34
Lime from oyster shells	31,439	26,400	248,911	7.92
Limestone (pulverized)	1,195,000	513,850	2,150,435	1.80
Calcareous marl	67,777	29,100	203,196	3.00
1923				
Lime from limestone:				
Quicklime	109,108	91,600	648,882	5.95
Hydrated	131,443	92,000	1,176,637	8.95
Lime from oyster shells	18,820	15,800	138,530	7.36
Limestone (pulverized)	1,278,770	549,870	2,160,249	1.69
Calcareous marl	99,410	42,700	328,932	3.31

The method by which the effective lime content of the different forms of land lime is calculated was set forth in Mineral Resources for 1921.

Detailed statistics of pulverized limestone sold for agriculture in 1923 will be found in the annual report on stone. All the calcareous marl sold in the United States in 1923 was used for liming the soil. Virginia produced 36,937 short tons, valued at $87,714, and California 18,303 short tons, valued at $109,437.

HYDRATED LIME

The statistics of the output of hydrated lime include only the product made in hydrating machines and omit hand-slacked lime. There were seven more plants reported as producing hydrated lime in 1923 than in 1922. Hydrated lime increased 11 per cent in quantity and 24 per cent in value in 1923.

Hydrated lime sold by producers in the United States, 1921–1923

Year	Short tons	Value		Number of plants in operation
		Total	Average	
1921	792,970	$7,421,637	$9.36	105
1922	1,106,063	9,868,980	8.92	114
1923	1,225,928	12,229,598	9.98	121

Hydrated lime sold by producers in the United States, 1922 and 1923, by uses

Use	1922		1923	
	Short tons	Value	Short tons	Value
Agricultural	150,423	$1,254,894	131,443	$1,176,637
Building	800,353	7,135,264	920,203	9,303,586
Chemical:				
Glass works	1,833	19,881	3,048	38,513
Metallurgy	1,930	19,085	12,638	117,819
Paper mills	10,305	101,945	15,674	151,276
Sugar refineries	6,337	59,943	2,704	28,460
Tanneries	16,736	167,318	20,093	199,523
Other uses	101,510	956,334	120,125	1,213,784
Total chemical	138,651	1,324,506	174,282	1,749,375
Sold to dealers (uses unknown)	16,636	154,316	------------	------------
	1,106,063	9,868,980	1,225,928	12,229,598

Hydrated lime sold by producers in the United States, 1922 and 1923, by States

State	1922		1923	
	Short tons	Value	Short tons	Value
Alabama	15,016	$140,698	19,526	$173,571
Arizona	(a)	(a)	(a)	(a)
California	(a)	(a)	(a)	(a)
Colorado	(a)	(a)	(a)	(a)
Connecticut	(a)	(a)	(a)	(a)
Florida	(a)	(a)	(a)	(a)
Georgia	(a)	(a)	(a)	(a)
Hawaii	160	3,633	(a)	(a)
Illinois	13,004	129,132	15,590	158,818
Indiana	38,832	344,775	43,051	435,313
Kentucky	----------	----------	(a)	(a)
Maine	(a)	(a)	(a)	(a)
Maryland	40,976	356,937	34,783	339,392
Massachusetts	(a)	(a)	(a)	(a)
Michigan	(a)	(a)	(a)	(a)
Minnesota	(a)	(a)	(a)	(a)
Missouri	56,024	551,187	63,823	674,848
Nevada	(a)	(a)	(a)	(a)
New Jersey	(a)	(a)	(a)	(a)
New York	(a)	(a)	(a)	(a)
Ohio	537,816	4,519,990	601,082	5,984,240
Pennsylvania	172,179	1,571,709	177,836	1,740,209
Rhode Island	(a)	(a)	(a)	(a)
South Dakota	(a)	(a)	----------	----------
Tennessee	26,029	231,120	40,558	385,955
Texas	21,163	203,687	22,935	223,735
Utah	(a)	(a)	(a)	(a)
Vermont	(a)	(a)	(a)	(a)
Virginia	15,284	123,039	32,189	280,444
Washington	(a)	(a)	(a)	(a)
West Virginia	49,712	369,122	52,954	428,587
Wisconsin	21,680	218,557	19,736	208,142
Undistributed	98,188	1,105,394	101,865	1,196,344
	1,106,063	9,868,980	1,225,928	12,229,598

[a] Included under "Undistributed."

CONSUMPTION

In the following table the consumption of lime is estimated by subtracting from the production the quantities reported shipped by producers out of their States and adding the quantities reported shipped in by producers in other States. No account is taken of jobbers' or dealers' interstate business nor of producers', jobbers', dealers', or consumers' stocks, which are quite unknown. Imports and exports are also ignored, but these are insignificant. The estimates are therefore not precise, but they afford the best approximations possible. On this basis almost all the States showed the same or a slightly higher per capita consumption in 1923, and the average for the country was higher. The lime produced in Ohio is more widely shipped than that from any other State; that of Missouri and Pennsylvania has the next widest distribution.

Lime consumed in the United States in 1923, by States, in short tons

State	Sales	Shipments from State	Shipments into State	Consumption					Population Jan. 1, 1924 [a]
				Quicklime	Hydrated lime	Total	Pounds per capita		
							1922	1923	
Alabama	193,429	47,432	5,887	140,029	11,855	151,884	110	125	2,434,731
Alaska	--------	--------	--------	--------	--------	--------	1	----	[b] 55,036
Arizona	18,764	16,562	5,052	6,921	333	7,254	20	37	387,645
Arkansas	14,941	7,525	5,356	9,715	3,057	12,772	13	14	1,825,441
California	66,703	7,470	43,453	89,571	13,115	102,686	48	53	3,859,194
Colorado	([c])	([c])	9,918	13,722	4,091	17,813	33	36	997,561
Connecticut	59,158	44,683	27,004	35,555	5,924	41,479	53	56	1,490,176
Delaware	--------	--------	23,049	12,661	10,388	23,049	190	199	231,524
District of Columbia	--------	--------	20,615	8,875	11,740	20,615	99	86	481,451
Florida	([c])	([c])	23,776	15,072	22,558	37,630	56	71	1,057,403
Georgia	([c])	([c])	31,825	14,583	23,153	37,736	23	25	3,013,961
Hawaii	([c])	--------	([c])	3,497	1,860	5,357	46	38	282,280
Idaho	([c])	([c])	983	2,123	260	2,383	8	10	475,651
Illinois	92,633	33,136	214,136	201,895	71,738	273,633	83	80	6,834,129
Indiana	126,296	73,177	51,708	52,641	52,186	104,827	67	69	3,024,955
Iowa	([c])	([c])	33,954	25,797	16,356	42,153	31	34	2,477,874
Kansas	--------	--------	26,569	14,976	11,593	26,569	29	29	1,801,522
Kentucky	([c])	([c])	28,949	19,765	11,295	31,060	22	25	2,468,843
Louisiana	--------	--------	38,701	26,280	12,421	38,701	36	42	1,857,066
Maine	139,781	85,608	23,421	74,321	3,273	77,594	199	199	778,579
Maryland	63,858	23,974	73,930	63,034	50,780	113,814	147	150	1,513,242
Massachusetts	180,720	138,883	95,563	118,959	18,441	137,400	58	68	4,052,572
Michigan	59,629	18,644	129,996	82,703	88,278	170,981	79	85	4,022,021
Minnesota	29,805	10,806	17,264	21,904	14,359	36,263	24	29	2,515,434
Mississippi	--------	--------	16,024	12,241	3,783	16,024	14	18	[b] 1,790,618
Missouri	246,326	166,543	29,737	85,570	23,950	109,520	55	63	3,449,673
Montana	([c])	([c])	2,097	2,597	1,812	4,409	13	14	620,101
Nebraska	--------	--------	15,702	8,091	7,611	15,702	23	23	1,339,286
Nevada	([c])	([c])	([c])	6,359	65	6,424	42	165	[b] 77,407
New Hampshire	--------	--------	14,855	13,318	1,537	14,855	83	66	448,237
New Jersey	([c])	--------	([c])	71,203	91,238	162,441	100	95	3,410,829
New Mexico	1,859	697	1,374	1,747	789	2,536	22	14	373,967
New York	100,862	40,711	384,937	304,251	140,837	445,088	74	82	10,909,152
North Carolina	([c])	([c])	64,171	42,848	26,311	69,159	49	51	2,704,497
North Dakota	--------	--------	4,655	1,630	3,025	4,655	34	14	675,637
Ohio	867,982	601,413	132,422	236,321	162,670	398,991	93	129	6,168,227
Oklahoma	([c])	([c])	14,675	9,686	5,545	15,231	34	14	2,181,194
Oregon	([c])	--------	([c])	5,075	1,904	6,979	14	17	828,967
Pennsylvania	772,839	273,304	235,974	566,504	169,005	735,509	153	161	9,154,657
Porto Rico	6,167	--------	15	6,167	15	6,182	9	9	1,374,712
Rhode Island	([c])	([c])	16,891	17,404	2,105	19,509	54	62	629,854
South Carolina	--------	--------	19,367	10,581	8,786	19,367	14	22	1,753,077
South Dakota	([c])	--------	([c])	4,259	1,255	5,514	22	17	658,244
Tennessee	131,995	88,065	9,671	37,965	15,636	53,601	42	45	2,400,962
Texas	62,822	14,424	862	29,350	19,910	49,260	17	20	4,979,117
Utah	12,228	3,956	60	7,395	937	8,332	34	35	480,729
Vermont	58,681	50,572	812	8,428	493	8,921	51	51	[b] 352,428
Virginia	182,604	127,940	36,529	63,041	28,152	91,193	73	76	2,411,192
Washington	25,895	15,502	730	9,912	1,211	11,123	21	15	1,445,054
West Virginia	241,601	219,176	52,383	57,178	17,630	74,808	77	96	1,563,650
Wisconsin	227,549	77,057	45,667	169,249	26,910	196,159	77	142	2,754,932
Wyoming	([c])	--------	([c])	2,000	1,245	3,245	27	30	214,358
Undistributed	91,116	34,400	183,088	--------	--------	--------	-----	-----	--------
	4,076,243	[d] 2,221,660	2,213,807	2,844,969	1,223,421	4,068,390	65	72	[e] 113,083,084

[a] Estimate by Bureau of the Census.

[b] Population Jan. 1, 1920; no estimate made.

[c] Included under "Undistributed."

[d] Inclusive of 6,700 tons shipped to Canada, 834 tons to Mexico, 111 tons to Cuba, 35 tons to New Zealand, 3 tons to Germany, and 170 tons unspecified.

[e] Estimate by Bureau of the Census for continental United States, plus Alaska, Hawaii, and Porto Rico as shown above.

EXPORTS AND IMPORTS[1]

Lime exported from the United States, 1921–1923

Year	Short tons	Value	
		Total	Average
1921	5,192	$109,769	$21.14
1922	8,289	116,649	14.07
1923	11,789	170,289	14.44

Lime exported from the United States, 1922–23, by countries

Country	1922		1923	
	Short tons	Value	Short tons	Value
North America:				
Canada	4,419	$49,443	6,895	$83,781
Newfoundland and Labrador			5	114
Mexico	1,663	22,959	2,486	34,664
Central America—				
British Honduras	5	104	4	73
Honduras	452	6,477	310	5,994
Nicaragua	26	619	117	3,251
Panama	71	1,848	94	2,189
Salvador			44	1,787
West Indies—				
British—				
Bermuda	6	123	27	774
Jamaica	9	250	5	146
Trinidad and Tobago			(a)	38
Other British	116	2,743	109	2,820
Cuba	135	2,465	245	5,100
Dominican Republic	649	13,473	951	18,543
Virgin Islands of the United States	13	474	30	843
South America:				
Bolivia			3	60
Brazil	1	24		
Chile	7	176	9	217
Colombia			17	581
Ecuador	(a)	21		
Peru	316	6,877	303	6,772
Venezuela	1	18	(a)	20
Europe:				
England	20	320	2	35
Sweden	1	50	1	50
Asia:				
China	40	624		
Japan	(a)	18		
Philippine Islands	331	7,292	77	1,605
Oceania:				
Australia	8	230		
New Zealand			55	832
Other British Oceania	(a)	21		
	8,289	116,649	11,789	170,289

[a] Less than 1 ton.

Lime imported for consumption in the United States, 1921–1923[a]

Year	Short tons	Value	
		Total	Average
1921	10,811	$234,798	$21.72
1922	14,112	290,845	20.61
1923	25,407	428,903	16.88

[a] Most of the lime imported into the United States comes from Canada.

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[1] Statistics of exports and imports compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, Department of Commerce.

FELDSPAR

By Jefferson Middleton

INTRODUCTION

Preceding volumes of Mineral Resources and other reports of the Geological Survey and reports of the Bureau of Mines contain information on changes and developments in the feldspar industry and on the composition, occurrence, and uses of feldspar, the geology and mineralogy of feldspar deposits, and the methods of mining and milling feldspar, and the reader desiring such information is referred to those publications. The principal reports are listed below.

Bastin, E. S., Economic geology of feldspar deposits of the United States: U. S. Geol. Survey Bull. 420, 1910.

Watts, A. S., Mining and treatment of feldspar and kaolin in the southern Appalachian region: Bur. Mines Bull. 53, 1913.

Watts, A. S., Feldspars of the New England and northern Appalachian States: Bur. Mines Bull. 92, 1916.

These reports are no longer available for free distribution, but the first and third may be purchased from the Superintendent of Documents, Washington, D. C., for 20 and 25 cents, respectively, or the three reports may be consulted in many of the public libraries of the United States. The following late papers on the subject are of interest:

Ladoo, R. B., Conditions in the feldspar industry: Bur. Mines Repts. Inv. 2311, January, 1922.

Watts, A. S., The marketing of feldspar: Eng. and Min. Jour.-Press, vol. 115, No. 12, pp. 535–538, Mar. 24, 1923.

Shaw, J. B., On the control of composition of feldspar: Ceramic Industry, vol. 2, No. 2, p. 91, February, 1924.

Staley, H. F., The feldspar problem in enamel making: Ceramist, vol. 4, No. 2, pp. 87–98, May, 1924.

PRODUCTION

Statistics of production of feldspar are presented separately in tabular form for mine and quarry output as crude feldspar and for mill output as ground feldspar. The crude feldspar is reported in long tons and the ground feldspar in short tons, according to common practice in the industry. The industry made considerable progress in 1923, and the output reached the highest quantity and value recorded. The average value of crude feldspar in 1923 at the shipping points nearest to the quarries was $7.29 a long ton—8 cents higher than that of 1922. The average value of domestic ground spar was 20 cents a ton lower than in 1922, and that of Canadian spar ground in the United States was 8 cents a ton higher. The average values for crude spar as reported by individual producers ranged from $2 to $12 a ton. For New England the range was from $4.55 to $12; for Maryland, New York, Pennsylvania, and Virginia, from $2 to $8.63; for North Carolina, from $3 to $7.69; and for Arizona, California, and Colorado, from $5 to $8.

Crude feldspar in 1923 was reported from 11 States, an addition of one (Arizona) compared with 1922. Maryland was the only State that showed a decrease in quantity and value in 1923. The total output increased about 24 per cent compared with 1922, and 7 per cent compared with 1920, the year of largest output prior to 1923. The value of the crude feldspar sold in 1923 was also the largest recorded and was 25 per cent greater than that of 1922 and 24 per cent greater than that of 1920.

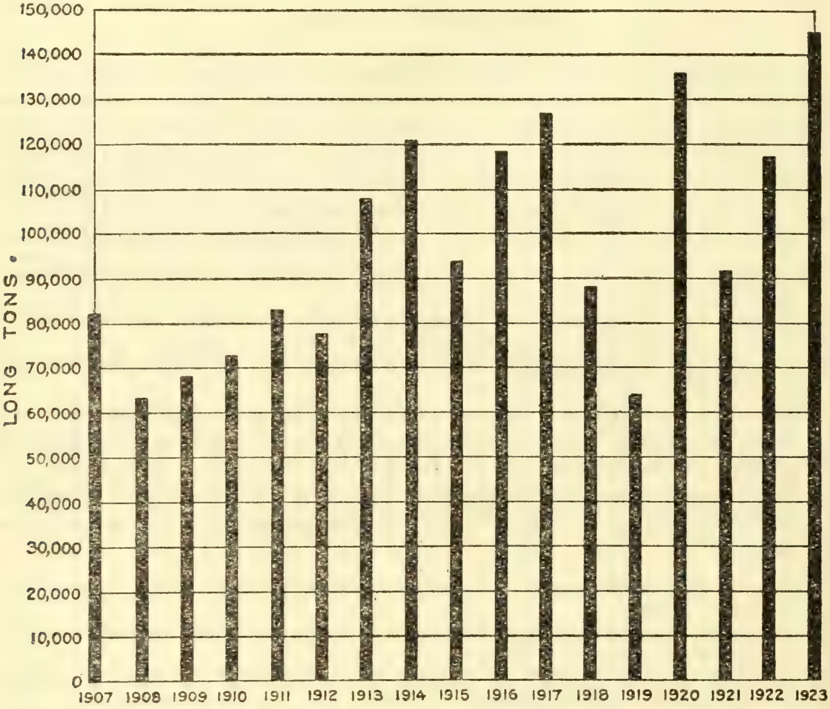

FIGURE 12.—Crude feldspar produced in the United States, 1907–1923

The reports for years preceding 1921 have shown a combination of figures of value for crude and ground feldspar as sold by the producers which gives a distorted view of the relative importance of the States in production of feldspar and also of the value per unit of quantity. In order to avoid such distortion all the feldspar sold by producers is now reported as crude and credited to the States in which it was produced at the average value of such feldspar in each State, in spite of the fact that much of the feldspar was first sold in the ground form.

The trend of production is shown in the accompanying diagram.

Crude feldspar, produced in the United States, sold in 1917–1923

Year	Long tons	Value	Year	Long tons	Value
1917	126, 715	$474, 767	1921	91, 865	$617, 652
1918	88, 498	429, 989	1922	117, 127	844, 568
1919	63, 441	347, 992	1923	145, 004	1, 057, 595
1920	135, 551	851, 123			

Crude feldspar, produced in the United States, sold in 1922 and 1923, by States

State	1922		1923		
	Long tons	Value [a]	Long tons	Value [a]	
				Total	Average
Arizona	----------	----------	(b)	(b)	$6. 00
California	2, 378	$17, 510	9, 297	$62, 499	6. 72
Colorado	104	580	(b)	(b)	5. 00
Connecticut	7, 499	47, 887	8, 780	75, 379	8. 59
Maine	21, 692	221, 478	25, 029	230, 122	9. 19
Maryland	2, 899	18, 099	2, 750	17, 010	6. 19
New Hampshire	14, 017	116, 751	23, 220	171, 789	7. 40
New York	(b)	(b)	15, 161	127, 477	8. 41
North Carolina	56, 043	333, 745	57, 622	360, 636	6. 26
Pennsylvania	(b)	(b)	2, 069	6, 355	3.07
Virginia	(b)	(b)	(b)	(b)	6. 26
Undistributed	12, 495	88, 518	1, 076	6, 328	----------
	117, 127	844, 568	145, 004	1, 057, 595	7. 29

[a] Value at mine or nearest shipping point.
[b] Included under "Undistributed."

Ground feldspar.—The available data relating to the production of ground feldspar have been unsatisfactory because they were incomplete. Probably all the feldspar consumed industrially is prepared by fine grinding except that used for facing cement work, for covering prepared roofing, and for "chicken grits" and like uses. Even for such purposes the spar is at least crushed to small sizes and more or less graded by screening, but it has not been possible to canvass all users of feldspar to determine the amounts ground and used by them. All known merchant mills or grinders—that is, those who quarry or purchase crude spar and grind it for sale to other establishments—have been canvassed for statistics of ground feldspar during the last three years.

For 1923, 26 mills in 11 States reported 177,229 short tons of ground feldspar sold, valued at $2,973,356, or $16.78 a ton. Of these mills 21 worked on domestic spar and 6 on Canadian spar, the mill of the New York Feldspar Corporation grinding both domestic and Canadian spar. Of the total quantity 86 per cent (151,855 tons) was domestic spar and 14 per cent (25,374 tons) was Canadian spar—about the same percentages as in 1922. The average value f. o. b. mills of all ground domestic spar was $16.38, and of Canadian spar $19.17 a ton. Direct comparison of values is misleading, however, as the figures for Canadian spar relate generally to high-grade material at mills near points of consumption, whereas the figures for domestic spar cover all grades at various points, some of which are distant from consuming centers. The average value of domestic spar ground at East Liverpool, Ohio, Trenton, N. J., and Wilmington, Del., approximately one-third of the total output, was $20.31, compared with $21.10 in 1922.

Values as reported by producers in East Liverpool and Trenton ranged from $19.77 to $21 a ton f. o. b. mills for various grades. In New England the corresponding range was $11.75 to $19.84. At Tennessee mills various grades of ground spar ranged from $8.50 to $16.14. Canadian ground spar ranged in New York from $18.18 to $20.10 a ton and in Ohio from $15 to $20.54 a ton.

Ground feldspar sold by merchant mills [a] *in the United States in 1923*

State	Number of operators	Domestic		Canadian	
		Short tons	Value	Short tons	Value
California, New York, and Ohio	9	21,667	$388,859	25,374	$486,546
Connecticut, Maine, and New Hampshire	7	41,324	729,945		
Delaware, Maryland, New Jersey, and Pennsylvania	6	41,392	811,467		
Tennessee	4	47,472	556,539		
	26	151,855	2,486,810	25,374	486,546

[a] Does not include potters and others who grind for consumption in their own plants.

THE INDUSTRY BY STATES

The production of crude feldspar in 1923 was reported from 11 States. Named in the order of their output, these were North Carolina, Maine, New Hampshire, New York, California, Connecticut, Maryland, Pennsylvania, Arizona, Virginia, and Colorado. This relative order is practically the same as that of 1922, the principal exceptions being the advance of California from seventh to fifth place and the appearance of Arizona as a producer. Feldspar was ground by merchant mills in each of these States except Arizona, Colorado, North Carolina, and Virginia. In addition, mills were operated in Delaware, New Jersey, Ohio, and Tennessee.

Arizona.—For the first time Arizona appeared as a producer of feldspar, a small output being reported from a deposit near Kingman, Mohave County. This material was shipped to California. The discoverer and operator of this deposit in 1923, G. I. Taylor, has been succeeded by the Kingman Feldspar Co., of Kingman.

California.—Six operators in Riverside and San Diego counties, Calif., reported the production of crude feldspar in 1923—nearly four times as much as in 1922. Most of it was sold crude.

Colorado.—Colorado has been an intermittent producer of feldspar in small lots. For 1923 production was reported by a single operator in Jefferson County. The material was used in the ceramic industry.

Connecticut.—Eight operators in Connecticut reported sales of crude feldspar in 1923 showing an increase of 17 per cent in quantity and 57 per cent in value over 1922. The principal producers, Louis W. Howe, the Eureka Flint & Spar Co., the Tidewater Feldspar Co., and the Capt. C. H. Cook Spar & Quartz Co., reported more than 80 per cent of the output. The last-mentioned company has abandoned its property and moved to North Carolina. The product of the Howe and Tidewater quarries was ground in mills belonging to the operators. The larger portion of the output of the other quarries was taken by mills in East Liverpool, Ohio, and Trenton, N. J., and used in the ceramic industry; the remainder was used in making soap.

Maine.—In 1923 Maine ranked second among the States in output of crude feldspar, as in 1922, and showed an increase of 15 per cent in quantity and 4 per cent in value. Eight operators in Androscoggin, Cumberland, Oxford, and Sagadahoc counties reported this output. The largest quantity was produced by the Maine Feldspar Co., which is also the largest producer of ground feldspar in the State. Maine ranked third in the quantity of domestic ground spar sold in 1923.

Maryland.—The production of crude feldspar in Maryland in 1923 showed a decrease of 5 per cent in quantity and 6 per cent in value compared with 1922. Maryland was the only State to show a decrease in output and value in crude feldspar in 1923. This material was produced principally by a large number of small miners reporting through the Product Operating Co. of Baltimore, which operates the only merchant mill in the State.

New Hampshire.—New Hampshire was the third largest producer of crude feldspar in 1923 and showed the largest increase both in quantity and value compared with 1922, though its proportional gain was not the largest. New Hampshire's product in 1923 was used in the ceramic and soap industries. The principal producer was the Golding-Keene Co., which succeeded during the year the Keene Mica Products Co. as a producer of crude spar.

New Jersey.—New Jersey is not a feldspar-producing State, but at Trenton are the mills of the Eureka Flint & Spar Co., the Golding Sons Co., and the Trenton Flint & Spar Co. This city is both one of the principal feldspar markets and one of the principal centers of feldspar consumption, by reason of its very large pottery industry and the large capacity of these mills.

New York.—The crude feldspar produced in New York in 1923 was mined by the Adironack Spar Mining Co., Essex County; the Bedford Mining Co., Westchester County; and the Green Hill Mining Co., St. Lawrence County. There were four mills in the State for grinding feldspar—those of the Bedford Mining Co., at Bedford, grinding domestic spar; the Dominion Feldspar Corporation at Rochester, and the Genesee Feldspar Co. (Inc.) at Rochester, grinding Canadian spar; and the New York Feldspar Corporation at Rochester, grinding both domestic and Canadian spar.

North Carolina.—North Carolina was the largest producer of feldspar in 1923, as it has been for several years. Its output showed an increase of about 3 per cent in quantity and 8 per cent in value compared with 1922. North Carolina's output constituted 40 per cent of the total quantity and its value was 34 per cent of the total for 1923. This output was produced by numerous small producers who sell or barter the feldspar at Spruce Pine, Penland, or other stations, principally on the Carolina, Clinchfield & Ohio Railway, whence it is taken by the milling companies or finally reaches the market through the larger and more firmly established producers. It is only through the courtesy of these companies in furnishing detailed statements of purchases that the Geological Survey is able to report the output of the region without endless duplication. Among the well-established operators who were active in 1923 were the Erwin Feldspar Corporation, the Carolina Mineral Co., the Clinchfield Products Corporation, the Penland Feldspar & Kaolin Co., and the Willms Co. (Inc.). No mills were operating in North Carolina during 1923. About 60 per cent of the North Carolina spar was ground in the mills in Tennessee, and 40 per cent in northern mills.

Ohio.—No feldspar was produced in Ohio, but as this State is the largest producer of pottery in the country, naturally it is a large consumer of feldspar. The Ohio potteries are supplied partly by the mills within the State operated by the Golding Sons Co. and the Potters Mining & Milling Co. at East Liverpool, the great pottery center; the Cleveland Feldspar & Products Co. at Cleveland; and the Rock Products Co. at Silica, near Toledo. The Golding Sons Co. ground only domestic spar in 1923, and the others ground only Canadian spar.

Pennsylvania.—Three operators reported feldspar production in Pennsylvania in 1923, but two of the operations were small. The lowest value for feldspar ($2 a ton) was reported in this State. The American Feldspar Co. operated a mill at Toughkenamon.

Tennessee.—The feldspar industry in Tennessee is represented only by grinding mills, of which there were four in operation in 1923. The mills of the Clinchfield Products Corporation, the Erwin Feldspar Corporation, and the Willms Co. (Inc.), are at Erwin, and that of the Tennessee Mineral Products Co. is at Bristol. Tennessee is the leading feldspar-grinding State; nearly one-third of the total domestic spar was ground there in 1923.

Virginia.—Two feldspar quarries were operated in Virginia in 1923, one by the Moneta Mineral & Mining Co. at Moneta, Bedford County, and the other by the Vicama Mica Co. at Axton, Henry County.

FOREIGN TRADE

The foreign trade of the United States in feldspar is small and limited largely to importing from Canada. There is no record of exports of feldspar, and if any they are doubtless negligible in quantity. Prior to September 22, 1922, imports of feldspar were not specifically classified in the official records and are therefore unknown. From that date to the end of the year the imports amounted to 7,549 long tons of crude feldspar, valued at $60,111, or $7.96 a ton, and 41 short tons of crushed or ground feldspar, valued at $538, or $13.12 a ton. In 1923 the imports of crude feldspar amounted to 24,271 long tons, valued at $184,924, or $7.62 a ton.

FOREIGN PRODUCTION

The supply of feldspar annually available for the ceramic and other feldspar-consuming industries in the United States is made up in considerable part of feldspar mined in Canada. According to reports of the Dominion Bureau of Statistics, the shipments in Canada in 1923 amounted to 29,483 short tons, valued at $214,346, or $7.27 a ton, all from Ontario and Quebec. This was an increase of 6 per cent in quantity but a decrease of 14 per cent in value. Of the total quantity 26,476 tons (90 per cent) was exported, most of it to the United States. The sales of Canadian spar ground in the United States in 1923 constituted 14 per cent of all ground spar sold in this country in that year. The increasing production of Canadian feldspar is undoubtedly cutting into the market for domestic spar, but as the production of domestic spar and the quantity of it ground are increasing more rapidly than the production of Canadian spar and the quantity of it ground in this country, the domestic industry does not seem to be menaced.

Feldspar, produced in Canada, sold in 1917–1923 [a]

Year	Short tons	Value	Year	Short tons	Value
1917	19, 462	$89, 826	1921	29, 868	$230, 754
1918	18, 782	112, 728	1922	27, 727	248, 402
1919	14, 679	86, 231	1923	29, 483	214, 346
1920	37, 873	280, 895			

[a] Statistics taken from reports on the mineral production of Canada, Canada Dept. of Mines, prior to 1921; for 1921, 1922, and 1923 from Dominion Bureau of Statistics.

The following table, prepared by Miss W. I. Whiteside, of the Geological Survey, shows the most recent figures for the production of feldspar in foreign countries. Aside from the United States and Canada, Sweden and Norway are the chief producing countries in recent years. The United Kingdom, though it has an immense pottery industry, appears to be a small producer of feldspar. Cornwall stone is extensively used as a flux in the British pottery industry rather than feldspar.

Feldspar output of principal producing countries, 1918–1923, in metric tons

Country [a]	1918	1919	1920	1921	1922	1923
Australia:						
New South Wales	----------	----------	----------	25	25	13
South Australia	----------	----------	4	----------	----------	20
Western Australia (exports)	----------	----------	----------	1	61	([b])
Canada	17, 039	13, 316	34, 358	27, 096	25, 153	26, 746
Finland	([b])	([b])	55	957	1, 322	([b])
France	([b])	([c])	4, 400	4, 625	2, 000	([b])
Germany (Bavaria)	3, 772	6, 527	5, 850	7, 249	6, 080	([b])
Italy	1, 517	1, 100	2, 600	2, 460	2, 790	5, 070
Norway	3, 488	5, 166	6, 397	9, 348	11, 833	([b])
Russia	([b])	([b])	([b])	([b])	685	([b])
Sweden	17, 850	12, 905	12, 049	20, 169	22, 371	([b])
United Kingdom	2, 461	4, 734	3, 419	1, 107	[d] 843	([b])
United States	89, 918	64, 459	137, 727	93, 339	119, 007	147, 331

[a] Sources of information—Australia: New South Wales, Dept. Mines Ann. Repts.; South Australia, Mines Dept. Mining Review; Western Australia, Dept. Mines Ann. Rept. Canada: 1918–1920, Canada Dept. Mines; 1921–1923, Dominion Bur. Statistics. Finland: Consular report, Oct. 30, 1923. France: 1919–20, Statisque de l'industrie minérale; 1921, data furnished by Direction des mines, Ministère des travaux publics, Paris. Germany: Consular report, March 18, 1922; Glückauf, July 19, 1924. Italy: Rivista del servizio minerario. Norway: Norges Bergverksdrift, Norges offisielle Statistikk. Russia: Gornyi Zhurnal, Nos. 3–4, 1923. Sweden: Bergshantering, Sveriges officiella Statistik. United Kingdom: Imp. Mineral Resources Bur., London.

[b] Data not available.

[c] No separate figures available; 49,978 tons of kaolin and feldspar reported.

[d] Exclusive of output of Ireland, for which no data are available.

CEMENT

By E. F. Burchard and B. W. Bagley

GENERAL REVIEW

A summary of the monthly estimates of output of Portland cement
n 1923, compiled from the monthly reports of producers, was pub-
ished by the United States Geological Survey early in January, 1924.
hese estimates, which indicated a production of about 137,400,000
arrels and shipments of about 135,900,000 barrels, were within
bout 0.6 and 0.2 per cent, respectively, of the final figures for 1923,
hich were released June 18, 1924.

The year 1923 began with both production and shipments of
ortland cement at a much higher rate than in January, 1922, and
owing an upward trend instead of the midwinter lag that has often
haracterized the output of cement. During the active season, from
ay to October, production and shipments attained higher levels
an in 1922, and at all times except in September and October there
as more than 6,000,000 barrels of cement in stock at the mills.

Comments by Portland cement manufacturers on trade conditions
1923 indicate that demand was generally better than in 1922 and
at shipping and manufacturing conditions were nearly everywhere
ore satisfactory, owing to better transportation facilities and
bsence of the coal shortages that in former years have been caused
y strikes. The increased demand was due almost entirely to large
ad contracts and increased building construction, although in places
nly one of these factors may have been operative. A very few slightly
nfavorable comments came from the Middle, Southwestern, and
orthwestern States. One encouraging comment was to the effect
at the improved financial standing of farmers had proved an aid
the cement industry.

A summary of value of buildings shown by permits issued during
920–1923 in 180 cities representing all parts of the United States
given in the following table to illustrate the general trend of building
nstruction during these years. The grand totals for the four years
ow successive increases, and in 1922 and 1923 there were increases
all districts, but in 1921 there were decreases in New England and
certain Eastern, Central, and Southwestern States.

In the second table is shown a summary of value of contracts
arded for buildings of all classes and for engineering construction
ork of all other kinds, including public works. The net increase
1923 for construction work of all kinds was considerably lower
an that for buildings alone.

Value of buildings shown by permits issued in 180 cities in the United States, 1920–1923 [a]

Group of cities	1920	1921	1922	1923	Increase in 1923 over 1922 (per cent)
New England	$101,449,000	$84,907,000	$152,680,000	$153,719,000	1
New York and northern New Jersey	369,711,000	562,755,000	773,747,000	977,231,000	26
Eastern Pennsylvania, southern New Jersey, Maryland, Delaware, District of Columbia, and Virginia	160,753,000	143,081,000	287,528,000	308,741,000	7
Western Pennsylvania, West Virginia, Ohio, and Kentucky	167,770,000	146,805,000	214,628,000	243,190,000	13
Illinois, Indiana, Iowa, Wisconsin, Michigan, Missouri, Kansas, Nebraska, and Oklahoma	295,225,000	341,117,000	556,604,000	726,467,000	30
Minnesota, North Dakota, and South Dakota	39,956,000	45,311,000	65,671,000	80,562,000	23
North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Arkansas, and Louisiana	78,759,000	79,630,000	119,858,000	145,596,000	21
Arizona and Texas	48,269,000	46,830,000	55,205,000	64,974,000	18
Colorado, Utah, Montana, and Idaho	13,357,000	16,327,000	25,911,000	31,627,000	22
California, Washington, and Oregon	168,927,000	201,989,000	302,006,000	408,351,000	35
	1,444,176,000	1,668,752,000	2,553,838,000	3,140,458,000	23

[a] From Bulletin of Portland Cement Association showing values tabulated in detail by cities, based on Bradstreet's and American Contractor building statistics.

Value of contracts awarded for building and all other construction work in all except Southeastern States, 1920–1923 [a]

Group of States	1920	1921	1922	1923	Increase or decrease, 1923 from 1922 (per cent)
New England	$306,935,000	$205,147,000	$333,572,000	$332,857,000	−0.2
New York and northern New Jersey	605,336,000	645,418,000	891,321,000	1,068,935,000	+20
Eastern Pennsylvania, southern New Jersey, Maryland, Delaware, District of Columbia, and Virginia	(b)	(b)	419,093,000	374,182,000	−11
Western Pennsylvania, West Virginia, Ohio, and Kentucky	(b)	(b)	532,352,000	593,995,000	+12
Illinois, Indiana, Iowa, Wisconsin, Michigan, Missouri, Kansas, Nebraska, and Oklahoma	(b)	(b)	1,092,008,000	1,006,422,000	−8
Minnesota, North and South Dakota, and northern Michigan	92,453,000	85,101,000	78,564,000	127,336,000	+62
	(b)	(b)	3,346,910,000	3,503,727,000	+5

[a] From Bulletin of Portland Cement Association, based on compilations by F. W. Dodge Co.

[b] Owing to rearrangement of districts, comparison of years prior to 1922 is impossible.

PRINCIPAL HYDRAULIC CEMENTS

The shipments of Portland and other (masonry, natural, and puzzolan) cements from the mills in the United States in 1923 increased more than 15 per cent in quantity and more than 24 per cent in value over the shipments in 1922.

Hydraulic cements shipped from mills in the United States, 1921–1923

Class	1921		1922		1923	
	Barrels	Value	Barrels	Value	Barrels	Value
Portland	95,507,147	$180,778,415	117,701,216	$207,170,430	135,912,118	$257,684,424
Masonry, natural, and puzzolan	539,402	897,025	889,428	1,293,598	1,271,674	1,947,352
	96,046,549	181,675,440	118,590,644	208,464,028	137,183,792	259,631,776

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

The total production of Portland cement in the United States in 1923, as reported to the United States Geological Survey, showed an increase of 20 per cent over that of 1922. The shipments from the mills showed increases of 15 per cent in quantity and more than 24 per cent in gross value. The average selling price at the mills increased 14 cents a barrel, or about 8 per cent. The production of 137,460,238 barrels of 376 pounds net is equivalent to 549,840,952 sacks, 23,073,683 long tons, or 25,842,525 short tons.

The statistics in the following table are arranged by States, so far as possible. The term "active plant" is applied to a mill or group of mills located at one place and operated by one company, but if a company operates establishments at different places its mill or group of mills at each place is counted as a plant. In the table by districts statistics are given for groups of States, generally not more than three, or parts of States, that are geographically and commercially related.

Of the 27 States in which Portland cement was manufactured in 1923, all but 1 showed an increase in production and all but 3 showed an increase in shipments, as compared with 1922. All the commercial districts showed increases in both production and shipments, the gains in production ranging from 6 to 33 per cent and in shipments from 5 to 24 per cent. The net change for the whole country was an increase of 20 per cent in production and of 15 per cent in shipments. In 1923 production exceeded shipments by 1,548,120 barrels.

The statistical tables show extraordinary increases in production in certain States or districts—for instance, in Alabama there was a gain of 53 per cent, and in the district in which this State is situated there was a gain of 33 per cent. Two large new mills (see p. 306) began producing cement in Alabama in 1923, and a third mill was enlarged. The production in other States, such as Ohio, Michigan, and Iowa, was likewise increased by the building of new mills. The increase in output in States where no new mills were built was as a rule due to increase in capacity of existing mills, stimulated no doubt by the increase in projected road-building and construction work, as, for example, in California.

Portland cement produced, shipped, and in stock in the United States, 1922 and 1923, by States

State	Production					Shipments							Stock		
	Active plants		Barrels		Increase, 1923 (per cent)	1922		1923		Average factory value per barrel		Increase in quantity, 1923 (per cent)	Barrels		Increase or decrease, 1923 (per cent)
	1922	1923	1922	1923		Barrels	Value	Barrels	Value	1922	1923		1922 (revised)	1923	
Alabama	3	5	2, 290, 884	3, 497, 256	53	2, 324, 116	$4, 135, 684	3, 395, 392	$6, 257, 673	$1. 78	$1. 84	46	34, 901	136, 765	+292
California	9	9	8, 711, 515	11, 001, 910	26	9, 041, 788	20, 478, 577	10, 882, 802	26, 022, 156	2. 26	2. 39	20	292, 486	411, 594	+41
Illinois	4	4	6, 407, 129	7, 147, 906	12	6, 554, 945	10, 584, 171	7, 129, 208	12, 550, 100	1. 61	1. 76	9	643, 244	661, 942	+3
Iowa	4	5	4, 272, 432	5, 732, 470	34	4, 475, 074	7, 709, 313	5, 570, 675	10, 351, 971	1. 72	1. 86	24	790, 447	952, 242	+20
Kansas	7	7	4, 634, 287	6, 025, 657	30	4, 556, 517	8, 138, 268	5, 878, 839	10, 868, 590	1. 79	1. 85	29	621, 927	768, 745	+24
Michigan	12	14	6, 243, 805	7, 619, 792	22	6, 349, 751	11, 145, 573	7, 466, 283	14, 038, 322	1. 76	1. 88	18	630, 383	783, 892	+24
Missouri	5	5	6, 170, 633	7, 305, 997	18	6, 239, 144	10, 457, 557	7, 143, 883	13, 237, 141	1. 68	1. 85	15	636, 625	798, 739	+25
New York	9	9	5, 922, 706	6, 990, 174	18	6, 194, 663	10, 694, 426	6, 853, 062	12, 834, 471	1. 73	1. 87	11	516, 151	653, 263	+27
Ohio	5	6	2, 835, 243	4, 188, 755	48	2, 913, 034	5, 243, 687	4, 003, 321	7, 615, 741	1. 80	1. 90	37	161, 797	347, 231	+115
Pennsylvania	22	22	33, 276, 093	38, 157, 482	15	34, 023, 695	55, 528, 002	38, 610, 852	69, 792, 343	1. 63	1. 81	13	2, 574, 229	2, 120, 859	−18
Texas	5	5	3, 628, 756	4, 178, 895	15	3, 730, 477	7, 515, 932	4, 091, 284	8, 011, 226	2. 01	1. 96	10	190, 762	278, 373	+46
Washington	4	4	1, 942, 781	2, 105, 711	8	1, 951, 414	4, 684, 624	2, 111, 479	4, 988, 022	2. 40	2. 36	8	246, 660	240, 892	−2
Other States [a]	29	31	28, 453, 720	33, 508, 233	18	29, 346, 598	50, 854, 616	32, 775, 038	61, 116, 668	1. 73	1. 86	12	2, 012, 638	2, 745, 833	+36
	118	126	114, 789, 984	137, 460, 238	20	117, 701, 216	207, 170, 430	135, 912, 118	257, 684, 424	1. 76	1. 90	15	9, 352, 250	10, 900, 370	+17

[a] Including Colorado, Georgia, Indiana, Kentucky, Maryland, Minnesota, Montana, Nebraska, New Jersey, Oklahoma, Oregon, Tennessee, Utah, Virginia, and West Virginia.

Portland cement produced, shipped, and in stock in the United States, 1922 and 1923, by districts

Commercial district	Production					Shipments							Stock		
	Active plants		Barrels		Increase, 1923 (per cent)	1922		1923		Average factory value per barrel		Increase in quantity, 1923 (per cent)	Barrels		Increase or decrease, 1923 (per cent)
	1922	1923	1922	1923		Barrels	Value	Barrels	Value	1922	1923		1922 (revised)	1923	
Eastern Pennsylvania, New Jersey, and Maryland	22	22	31, 195, 617	35, 721, 751	15	31, 897, 649	$51, 953, 144	36, 133, 963	$65, 536, 543	$1. 63	$1. 81	13	2, 295, 324	1, 883, 112	−18
New York	9	9	5, 922, 706	6, 990, 174	18	6, 194, 663	10, 694, 426	6, 853, 062	12, 834, 471	1. 73	1. 87	11	516, 151	653, 263	+27
Ohio, western Pennsylvania, and West Virginia	10	11	10, 753, 301	13, 495, 799	26	11, 040, 908	18, 586, 754	13, 211, 380	24, 183, 471	1. 68	1. 83	20	776, 261	1, 060, 680	+37
Michigan	12	14	6, 243, 805	7, 619, 792	22	6, 349, 751	11, 145, 573	7, 466, 283	14, 038, 322	1. 76	1. 88	18	630, 383	783, 892	+24
Illinois, Indiana, and Kentucky	10	10	17, 998, 914	21, 193, 666	18	18, 676, 656	30, 159, 728	21, 056, 914	37, 010, 579	1. 61	1. 76	13	1, 434, 407	1, 571, 159	+10
Virginia, Tennessee, Alabama, and Georgia	8	11	5, 954, 043	7, 908, 846	33	6, 158, 652	10, 854, 347	7, 620, 850	14, 210, 617	1. 76	1. 86	24	169, 597	457, 593	+170
Eastern Missouri, Iowa, and Minnesota	9	10	11, 392, 552	14, 037, 099	23	11, 657, 484	19, 528, 016	13, 624, 173	25, 022, 674	1. 68	1. 84	17	1, 516, 568	1, 929, 494	+27
Western Missouri, Nebraska, Kansas, and Oklahoma	11	11	8, 025, 720	9, 779, 034	22	7, 967, 266	14, 570, 823	9, 573, 003	18, 185, 384	1. 83	1. 90	20	956, 887	1, 162. 918	+22
Texas	5	5	3, 628, 756	4, 178, 895	15	3, 730, 477	7, 515, 932	4, 091, 284	8, 011, 226	2. 01	1. 96	10	190, 762	278, 373	+46
Colorado and Utah	5	5	2, 020, 784	2, 427, 971	20	2, 063, 500	4, 609, 605	2, 340, 386	5, 163, 340	2. 23	2. 21	13	202, 608	290, 193	+43
California	9	9	8, 711, 515	11, 001, 910	26	9, 041, 788	20, 478, 577	10, 882, 802	26, 022, 156	2. 26	2. 39	20	292, 486	411, 594	+41
Oregon, Washington, and Montana	8	9	2, 942, 271	3, 105, 301	6	2, 922, 422	7, 073, 505	3, 058, 018	7, 465, 641	2. 42	2. 44	5	370, 816	418, 099	+13
	118	126	114, 789, 984	137, 460, 238	20	117, 701, 216	207, 170, 430	135, 912, 118	257, 684, 424	1. 76	1. 90	15	9, 352, 250	10, 900, 370	+17

The following table, showing production, shipments, and stocks by months for 1922 and 1923, has been compiled mainly from reports of producers but includes estimates for the output of one or two plants each month. Although the figures only approximate the totals shown in other tables of this report that are based on final annual returns from the producers, they reflect the fluctuations in the industry during the year. Production of Portland cement is necessarily curtailed to some extent in December, January, and February in the colder parts of the United States at plants using marl as a raw material and at other plants where the wet process is employed, and numerous other mills also close for repairs in the winter, when the demand is least strong. Movements now on foot to create a steadier demand for cement appear to be making progress. In connection with the stock of finished cement available by months throughout the year the quantity of clinker, or unground cement, also in reserve at the mills is of interest, and the second following table shows these quantities as estimated by the manufacturers.

Estimated production, shipments, and mill stocks of Portland cement in the United States, by months, 1922 and 1923, in barrels

Month	1922			1923		
	Production	Shipments	Stocks on last day of the month	Production	Shipments	Stocks on last day of the month
January	4, 291, 000	2, 931, 000	13, 316, 000	7, 990, 000	5, 628, 000	11, 477, 000
February	4, 278, 000	3, 285, 000	14, 142, 000	8, 210, 000	6, 090, 000	13, 596, 000
March	6, 685, 000	7, 002, 000	13, 848, 000	9, 880, 000	10, 326, 000	13, 045, 000
April	9, 243, 000	8, 592, 000	14, 470, 000	11, 359, 000	12, 954, 000	11, 463, 000
May	11, 176, 000	12, 749, 000	12, 893, 000	12, 910, 000	14, 257, 000	10, 144, 000
June	11, 245, 000	13, 470, 000	10, 718, 000	12, 382, 000	13, 307, 000	9, 168, 000
July	11, 557, 000	13, 850, 000	8, 433, 000	12, 620, 000	13, 712, 000	8, 081, 000
August	11, 664, 000	14, 361, 000	5, 746, 000	12, 967, 000	14, 971, 000	6, 080, 000
September	11, 424, 000	12, 444, 000	4, 724, 000	13, 109, 000	13, 698, 000	5, 533, 000
October	12, 287, 000	12, 854, 000	4, 149, 000	13, 350, 000	14, 285, 000	4, 612, 000
November	11, 349, 000	10, 167, 000	5, 320, 000	12, 603, 000	10, 251, 000	6, 991, 000
December	8, 671, 000	4, 858, 000	9, 352, 000	9, 997, 000	6, 408, 000	10, 900, 000

Estimated clinker, or unground cement, at the mills in the United States, at end of each month, 1922 and 1923, in barrels

Month	1922	1923	Month	1922	1923
January	4, 527, 000	4, 015, 000	July	4, 833, 000	3, 865, 000
February	5, 954, 000	4, 646, 000	August	2, 766, 000	3, 759, 000
March	6, 810, 000	5, 174, 000	September	2, 336, 000	3, 379, 000
April	6, 894, 000	5, 006, 000	October	1, 935, 000	3, 008, 000
May	6, 318, 000	4, 470, 000	November	1, 949, 000	2, 908, 000
June	5, 851, 000	4, 172, 000	December	2, 849, 000	3, 783, 000

Portland cement shipped from mills in the United States, 1918–1923

Year	Barrels	Value	Year	Barrels	Value
1918	70, 915, 508	$113, 316, 275	1921	95, 507, 147	$180, 778, 415
1919	85, 612, 899	146, 734, 844	1922	117, 701, 216	207, 170, 430
1920	96, 311, 719	194, 439, 025	1923	135, 912, 118	257, 684, 424

The stock of Portland cement reported on hand at the mills at the end of 1923 showed an increase of 17 per cent over that at the end of 1922 and was in excess of the average for the last six years (9,497,700 barrels). In fact, the stocks at the end of 1923 were exceeded only in 4 of the 13 years during which records of stocks have been kept by the Geological Survey. The reports of stocks at a few mills in 1922 were revised by the producers. The totals by States and districts are shown in preceding tables.

Finished Portland cement in stock at mills in the United States, December 31, 1918 to 1923

	Barrels		Barrels
1918	10, 451, 044	1921	12, 192, 567
1919	5, 256, 900	1922	9, 352, 250
1920	8, 833, 067	1923	10, 900, 370

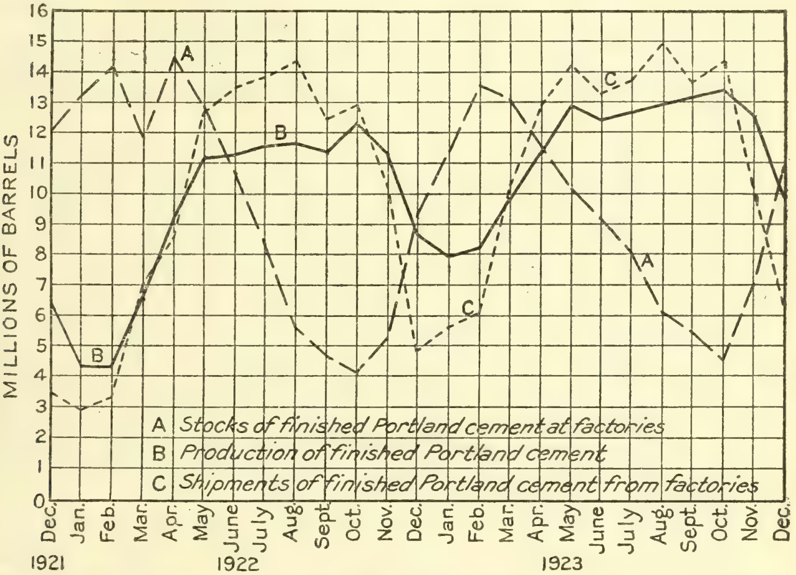

FIGURE 13.—Monthly fluctuations in production, shipments, and stocks of finished Portland cement, 1922 and 1923

DOMESTIC CONSUMPTION

An estimate of the total consumption of Portland cement in the United States may be made by adding the imports to the shipments and subtracting the exports from the sum. Of course a variable but considerable stock of cement is at all times in transit, in warehouses at distributing points, and awaiting use at jobs, so that the estimate thus made is at best only approximate. Still another uncertain element in this estimate is the fact that as the cement imported and exported is classed as hydraulic cement the records do not discriminate between Portland and other cements and probably also include some plaster. Portland cement, however constitutes by far the greater part of the exports. The apparent domestic consumption in 1923 showed an increase of nearly 17 per cent as compared with the consumption in 1922.

Portland cement available for domestic consumption in the United States, 1918–1923, in barrels

Year	Shipments	Imports	Exports	Available for consumption
1918	70, 915, 508	305	2, 252, 446	68, 663, 367
1919	85, 612, 899	8, 931	2, 463, 573	83, 158, 257
1920	96, 311, 719	524, 604	2, 985, 807	93, 850, 516
1921	95, 507, 147	122, 322	1, 181, 014	94, 448, 455
1922	117, 701, 216	323, 823	1, 127, 845	116, 897, 194
1923	135, 912, 118	1, 678, 636	1, 001, 688	136, 589, 066

The estimates of consumption of Portland cement are furthermore only approximate because they represent only the records of shipments by manufacturers into the several States. The shipments of cement into a State during a year may not equal the consumption in that State during the same year, but shipments for a long period should afford a very fair index to the consumption.[1] The simplest available common unit is the estimated consumption per capita in barrels, which is obtained by comparing the shipments into States with the population for the States in 1922 and 1923. The estimates of population in the following table were furnished by the Bureau of the Census.

There is a difference between the official figures of the Bureau of Foreign and Domestic Commerce for exports of cement, as given on page 314, and the exports reported by manufacturers, as given in the following table, owing to the fact that cement shipped from mills destined for foreign countries and for Alaska, Hawaii, and Porto Rico is reported by the shipper as exported, whether or not it leaves the country during that calendar year, but the Bureau of Foreign and Domestic Commerce bases its export figures on the cement that actually leaves the country, according to its records. (The shipments to Alaska, Hawaii, and Porto Rico are given on p. 315.) The exports given by that bureau for 1923 include all other hydraulic cement exported, whereas the table of per capita consumption relates only to Portland cement, but for 1922 Portland and natural cements are given separately.

The per capita consumption shown by the table necessarily falls short of the total apparent consumption by the quantity of the imports. These increase the consumption in certain States near the Canadian border and in those having seaports; in 1923 they increased the general average per capita consumption by about 0.015 barrel.

The highest per capita consumption in 1923 was that of California, 2.69 barrels. This State also held the record in 1922, 2.23 barrels, and it was second only to Wyoming in its increase in 1923. There were 26 States in which the per capita consumption in 1923 was 1 barrel or more, 12 of them west and 14 of them east of Mississippi River. Two of these States, North Carolina and Florida, were in the South. Changes occurred in all the States except Colorado, Oregon, and South Carolina, and only six decreases were recorded. The general average consumption was 1.21 barrels, compared with 1.06 barrels in 1922. This is the highest average per capita consumption for the United States on record, the range hitherto since 1914 having been from 0.64 to 1.06 barrels.

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[1] Data on per capita consumption of Portland cement by States beginning with the year 1914 are given in preceding volumes of Mineral Resources.

Shipments of domestic cement from mills into States and per capita, 1922 and 1923

State	1922			1923		
	Population Jan. 1, 1923, estimated [a]	Shipments to States, in barrels		Population Jan. 1, 1924, estimated [a]	Shipments to States, in barrels	
		Total	Per capita		Total	Per capita
Alabama	2,413,092	998,009	0.41	2,434,731	1,489,531	0.61
Arizona [b]	374,274	633,999	1.69	387,645	485,544	1.25
Arkansas [b]	1,807,132	498,075	.28	1,825,441	848,509	.46
California	3,751,111	8,356,362	2.23	3,859,194	10,373,163	2.69
Colorado	983,078	1,093,026	1.11	997,561	1,106,920	1.11
Connecticut [b]	1,462,790	1,262,018	.86	1,490,176	1,441,271	.97
Delaware [b]	229,394	353,201	1.54	231,524	404,996	1.75
District of Columbia [b]	[c] 437,571	661,865	1.51	481,451	756,723	1.57
Florida [b]	1,035,170	924,112	.89	1,057,403	1,299,746	1.23
Georgia	2,984,429	1,084,395	.36	3,013,961	1,424,552	.47
Idaho [b]	464,705	257,253	.55	475,651	291,029	.61
Illinois	6,746,917	9,667,741	1.43	6,834,129	12,237,478	1.79
Indiana	3,001,314	3,894,909	1.30	3,024,955	5,010,588	1.66
Iowa	2,459,411	3,246,436	1.32	2,477,874	3,624,857	1.46
Kansas	1,793,456	2,692,345	1.50	1,801,522	2,613,070	1.45
Kentucky	2,455,790	1,163,279	.47	2,468,843	1,566,682	.63
Louisiana [b]	1,842,427	906,467	.49	1,857,066	1,028,520	.55
Maine [b]	775.938	461,749	.60	778,579	510,339	.66
Maryland	1,497,347	1,547,304	1.03	1,513,242	1,827,684	1.21
Massachusetts [b]	4,002,518	3,045,511	.76	4,052,572	3,124,238	.77
Michigan	3,933,619	6,196,586	1.58	4,022,021	7,531,664	1.87
Minnesota	2,483,357	3,555,842	1.43	2,515,434	3,414,916	1.36
Mississippi [b]	[c] 1,790.618	422,591	.24	[c] 1,790,618	457,907	.26
Missouri	3,438,268	3,017,859	.88	3,449,673	3,492,453	1.01
Montana	602,298	265,294	.44	620,101	280,682	.45
Nebraska	1,328,557	1,606,062	1.21	1,339,286	1,497,040	1.12
Nevada [b]	[c] 77,407	91,646	1.18	[c] 77,407	92,760	1.20
New Hampshire [b]	446.948	365,210	.82	448,237	359,574	.80
New Jersey	3,347,097	5,116,282	1.53	3,410,829	5,400,703	1.58
New Mexico [b]	370,563	269,351	.73	373,967	222,482	.59
New York	10,778,171	13,272,157	1.23	10,909,152	15,881,436	1.46
North Carolina [b]	2,668,153	2,284,502	.86	2,704,497	3,108,367	1.15
North Dakota [b]	668,446	284,422	.43	675,637	302,734	.45
Ohio	6,066,019	7,770,331	1.28	6,168,227	8,843,641	1.43
Oklahoma	2,142,966	2,023,392	.94	2,181,194	2,120,313	.97
Oregon	817,572	943,819	1.15	828,967	956,320	1.15
Pennsylvania	9,045,997	10,457,809	1.16	9,154,657	11,281,290	1.23
Rhode Island [b]	623,490	453,950	.73	629,854	509,584	.81
South Carolina [b]	1,735,739	628,952	.36	1,753,077	626,912	.36
South Dakota [b]	652,820	507,084	.78	658,244	564,807	.86
Tennessee	2,385,193	939,174	.39	2,400,962	1,267,245	.53
Texas	4,900,145	2,892,922	.59	4,979,117	3,328,619	.67
Utah	472,895	450,460	.95	480,729	476,186	.99
Vermont [b]	[c] 352,428	213,255	.61	[c] 352,428	234,182	.66
Virginia	2,385,690	1,432,326	.60	2,411,192	1,742,200	.72
Washington	1,422,945	1,750,811	1.23	1,445,054	1,926,019	1.33
West Virginia	1,538,662	1,478,476	.96	1,563,650	1,817,112	1.16
Wisconsin [b]	2,724,215	4,584,298	1.68	2,754,932	5,064,404	1.84
Wyoming [b]	209,369	228,265	1.09	214,358	348,805	1.63
Unspecified		55,813			87,516	
	[d] 109,955,947	116,306,997	1.06	[d] 111,371,056	134,703,313	1.21
Exports reported by manufacturers but not included above [e]		1,394,219			1,208,805	
Total shipped from cement plants		117,701,216			135,912,118	

[a] Bureau of the Census.
[b] Non cement-producing State.
[c] Population Jan. 1, 1920.
[d] Total for continental United States.
[e] Includes shipments to Alaska, Hawaii, and Porto Rico.

LOCAL SUPPLIES

By comparing the shipments from the mills within a State or group of States with the estimated consumption in the same area it is possible to ascertain the surplus or deficiency in the supply of cement locally available. The following table has been arranged with that end in view, and the consumption in the non cement-producing States is shown in the general table above. Data for 1916 to 1921 will be found in Mineral Resources for 1917 to 1921.

The surplus shown in the following table was distributed, by years, as follows: In 1922, to non cement-producing States, 19,337,776 barrels; to foreign countries and to Alaska, Hawaii, and Porto Rico, 1,394,219 barrels; unspecified, 55,813 barrels; in 1923, to non cement-producing States, 22,083,433 barrels; to foreign countries and to Alaska, Hawaii, and Porto Rico, 1,208,805 barrels; unspecified, 87,516 barrels.

Among the cement-producing States there are, of course, fewer deficiencies than surpluses, and certain of the deficiencies indicated are due to local conditions that did not change materially from 1922 to 1923. For instance, in 1923 Ohio showed a deficiency of more than 4,840,000 barrels, which was largely supplied from Pennsylvania's surplus of more than 27,300,000 barrels and from Indiana. New York, though a large producer, had a deficiency of more than 9,000,000 barrels, which was mostly supplied from the Lehigh district in Pennsylvania. In Maryland, New Jersey, and West Virginia there was a shortage of more than 2,300,000 barrels, probably supplied in large part from the Lehigh district. The quantities consumed in the nonproducing States are of interest in comparison with the other data. Between 500,000 and 1,000,000 barrels was consumed in 1923 in each of the States of Arkansas, Maine, Rhode Island, South Carolina, South Dakota, and the District of Columbia. Louisiana consumed more than 1,000,000 barrels, Florida nearly 1,300,000 barrels, Connecticut more than 1,400,000 barrels, Massachusetts and North-Carolina more than 3,100,000 barrels each, and Wisconsin more than 5,000,000 barrels.

Estimated surplus or deficiency in local supply of Portland cement in cement-producing States, 1922–1923, in barrels

State or division	1922			1923		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama	2, 324, 116	998, 009	+1, 326, 107	3, 395, 392	1, 489, 531	+1, 905, 861
California	9, 041, 788	8, 356, 362	+685, 426	10, 882, 802	10, 373, 163	+509, 639
Illinois	6, 554, 945	9, 667, 741	−3, 112, 796	7, 129, 208	12, 237, 478	−5, 108, 270
Iowa	4, 475, 074	3, 246, 436	+1, 228, 638	5, 570, 675	3, 624, 857	+1, 945, 818
Kansas	4, 556, 517	2, 692, 345	+1, 864, 172	5, 878, 839	2, 613, 070	+3, 265, 769
Michigan	6, 349, 751	6, 196, 586	+153, 165	7, 466, 283	7, 531, 664	−65, 381
Missouri	6, 239, 144	3, 017, 859	+3, 221, 285	7, 143, 883	3, 492, 453	+3, 651, 430
New York	6, 194, 663	13, 272, 157	−7, 077, 494	6, 853, 062	15, 881, 436	−9, 028. 374
Ohio	2, 913, 034	7, 770, 331	−4, 857, 297	4, 003, 321	8, 843, 641	−4, 840, 320
Pennsylvania	34, 023, 695	10, 457, 809	+23, 565, 886	38, 610, 852	11, 281, 290	+27, 329, 562
Texas	3, 730, 477	2, 892, 922	+837, 555	4, 091, 284	3, 328, 619	+762, 665
Colorado and Utah	2, 063, 500	1, 543, 486	+520, 014	2, 340, 386	1, 583, 106	+757, 280
Oregon, Washington, and Montana	2, 922, 422	2, 959, 924	−37, 502	3, 058, 018	3, 163, 021	−105, 003
Georgia, Kentucky, Tennessee, and Virginia	4, 436, 003	4, 619, 174	−183, 171	4, 928, 522	6, 000, 679	−1, 072, 157
Indiana, Minnesota, Nebraska, and Oklahoma	15, 874, 259	11, 080, 205	+4, 794, 054	17, 828, 421	12, 042, 857	+5, 785, 564
Maryland, New Jersey, and West Virginia	6. 001, 828	8, 142, 062	−2, 140, 234	6, 731, 170	9, 045, 499	−2, 314, 329
	117, 701, 216	96, 913, 408	+20, 787, 808	135, 912, 118	112, 532, 364	+23, 379, 754

PRICES

At factories.—Average values of Portland cement sold at the factories, as reported to the Geological Survey, are shown in the tables of shipments by States and districts during 1922 and 1923. The averages by States ranged from $1.73 a barrel in Minnesota to $2.39 in California in 1923, compared with a range from $1.60 in

Indiana to $2.62 in Oregon in 1922. The averages by districts ranged from $1.76 in the Illinois-Kentucky-Indiana district to $2.44 in the Oregon-Washington-Montana district in 1923, compared with a range of $1.61 to $2.42 in the same districts in 1922. The general average value for the whole country showed an increase in 1923 of nearly 8 per cent, and averages increased in all the districts except Colorado-Utah and in all the States except Colorado, Texas, Utah, and Washington.

The average factory value of Portland cement may be slightly higher in certain States than it would be if the ordinary structural cement were the only kind produced, on account of the marketing of certain special cements that command a higher price. Among these are white Portland cement, made in Pennsylvania, and cements made particularly for shutting out water in oil wells and for stucco finish, both made in Califonia. Oil-well work requires a rapid-setting cement, and for stucco work a cement that is more than ordinarily plastic and waterproof is desirable.

Average factory value per barrel in bulk of Portland cement, 1912–1923

1912	$0.813	1916	$1.103	1920	$2.02
1913	1.005	1917	1.354	1921	1.89
1914	.927	1918	1.598	1922	1.76
1915	.860	1919	1.714	1923	1.90

At markets.—A summary of wholesale prices of Portland cement in bulk in carload lots at the principal cities of the United States and at Montreal, Canada, by months, for 1922 and 1923, as published in the Engineering News-Record, is given below. This table is not absolutely consistent, as is indicated in the footnotes, and there are some inconsistencies that are not accounted for by the footnotes, such as sudden large changes in prices. The figures in this table are susceptible of comparison in several different ways. Comparison of prices at a single locality between corresponding months of 1922 and 1923 and between the several months of the same year can readily be made, as well as comparisons between prices at different localities. Nearly everywhere prices were higher throughout 1923 than in corresponding periods of 1922, and the trend of prices during 1923 indicates that in the winter months lower prices prevailed. The net result of the movement of market prices in 1922, as with factory prices, was downward, the decreases ranging between 4 and 56 cents a barrel, and in 1923 it was upward, the increases reaching 50 cents a barrel or more in places. Seattle, Wash., is the only place at which the prices remained practically stationary, and prices here appear to have remained nearly the same throughout 1922 and 1923. Other places at which prices appear to have been higher than would seem to be justified by their location with respect to mills and transportation routes were Atlanta, New Orleans, and Baltimore, although at Baltimore the prices appear to include cost of delivery. The extraordinarily high price of $3.50 a barrel at Atlanta in May, 1923, may be questioned as to accuracy, as it stands as a single quotation preceded and succeeded by lower prices within intervals of one week. As might be expected, the lowest market prices were quoted at cities near which Portland cement is manufactured, such as Duluth, Chicago, Pittsburgh, St. Louis, Birmingham, and Dallas, but there are other cities where the proximity of cement mills might be expected to bring about lower prices than the table shows. In New York two scales of prices are quoted, the higher for cement delivered, the lower for cement alongside dock, the difference ranging from 10 to 40 cents a barrel, but this difference does not show any marked influence of foreign cement, nor do the prices at Los Angeles indicate the competition that has been exerted by imported cement.

The differences between average factory values for 1922 and 1923, by districts, and the market prices of cement at the principal cities within the several districts as a rule do not appear to be excessive when all the elements that enter into these differences are taken into consideration. In 1922 they ranged from 24 cents to $1.05 a barrel and in 1923 from 9 cents to $1.41 a barrel. In most districts these differences were less than 75 cents a barrel in both years.

The increase in the prices of building materials, along with those of all other commodities, since the beginning of the World War has so seriously affected the living conditions of the people that many inquiries into the price situation have naturally followed, as well as efforts to protect the public against organized price manipulation.

In view of the fact that the annual per capita consumption of Portland cement in the United States has reached nearly 1¼ barrels and promises to continue to increase, the prices of this essential building material have attracted particular interest, and considerable information is now available to show their position among those of other structural materials and to explain the economic conditions by which they are determined. Data of interest in this connection compiled by the United States Bureau of Labor Statistics, Department of Labor, are given below. This list comprises the principal building materials, but a few materials of minor importance showed a smaller percentage of increase than cement.

Comparative prices of building materials in December, 1923 [2]

[Percentage of increase over prices in 1913]

Building materials in general, simple average, 43 types	79. 8
Lime (lump), average, United States	139. 5
Plate glass, 3 to 5 feet, New York	132. 4
Turpentine, New York	119. 1
Brick, common, simple average at 82 brickyards	116. 2
Linseed oil, New York	98. 7
Douglas fir, No. 1, common at mills	90. 1
Yellow-pine flooring, B and better, at mills	83. 2
Oak, plain white, No. 1, Cincinnati	75. 6
Portland cement, simple average at 6 representative plants	74. 9

A detailed analysis of the current position of prices and price levels in the Portland cement industry, published early in 1924, is commended to the attention of all who wish to study this subject.[3] The authors availed themselves of four Government sources of information as to cement prices and of many series of monthly and weekly prices issued by engineering and trade journals. They also had the advantage of making an examination of the earnings of cement companies during 1922 as indicated in their income-tax statements filed with the Treasury Department for that year. These data have been published in tabular form and analyzed in the treatise, which also outlines the history of the cement industry.

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[2] Wholesale prices of commodities for December, 1923, pp. 6–7, U. S. Department of Labor, Bureau of Labor Statistics, 1924.

[3] Willis, H. P., and Byers, John R. B., Portland cement prices, their basis, character, and present position, 123 pp., New York, Ronald Press Co., 1924.

Wholesale prices of Portland cement per barrel in bulk in carload lots, 1922 and 1923, by months [a]

City	January		February		March		April		May		June	
	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923
Atlanta	$2.55	$2.54	$2.69	$2.50	$2.39	$2.75	$2.39	$2.90	$2.39	$3.50	$2.34	$2.85
Baltimore	[b]2.50	------	2.50	2.51	2.50	2.61	2.50	2.61	2.50	3.05	2.50	2.65
Birmingham	2.27	2.40	2.27	2.40	2.27	2.40	2.27	2.50	2.27	2.50	2.27	2.50
Boston	2.52	2.85	2.50	2.75	2.50	2.75	2.50	2.75	2.50	2.80	2.50	2.80
Cedar Rapids	2.28	2.33	2.26	2.33	2.11	2.48	2.21	2.48	2.21	2.48	2.31	2.48
Chicago	1.97	2.05	1.97	2.05	1.94	2.20	1.97	2.20	1.97	2.20	2.07	2.20
Cincinnati	2.37	2.39	2.35	2.39	2.32	2.54	2.35	2.54	2.35	2.54	2.45	2.54
Cleveland	2.28	2.36	2.26	2.36	2.26	2.46	2.26	2.46	2.26	2.46	2.36	2.46
Dallas	2.55	2.25	2.40	2.25	2.40	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Davenport	2.22	2.28	2.21	2.28	2.06	2.43	2.16	2.43	2.16	2.43	2.24	2.43
Denver	3.10	2.85	2.90	2.85	2.90	2.85	2.90	2.85	2.90	2.85	2.90	2.84
Detroit	2.31	2.33	2.17	2.33	2.17	2.47	2.17	2.47	2.17	2.47	2.37	2.48
Duluth	1.95	2.04	1.95	2.04	1.95	2.14	1.94	2.14	1.94	2.14	2.04	2.14
Indianapolis	2.23	2.26	2.21	2.26	2.21	2.41	2.21	2.41	2.21	2.41	2.31	2.41
Jersey City	2.12	2.48	2.12	2.48	2.12	2.48	2.12	2.48	2.12	2.48	2.32	2.48
Kansas City	2.45	2.45	2.40	2.35	2.40	2.45	2.40	2.42	2.40	2.42	2.40	2.45
Los Angeles	3.31	------	3.31	------	3.30	------	3.30	3.40	3.30	3.80	3.30	3.20
Milwaukee	2.19	2.22	2.18	2.22	2.13	2.37	2.18	2.37	2.18	2.37	2.26	2.37
Minneapolis	2.26	2.29	2.24	2.29	2.24	2.39	2.24	2.39	2.24	2.39	2.34	2.39
Montreal	[b]3.10	2.40	2.65	2.15	[b]2.40	[b]2.88	[b]2.40	[b]2.88	[b]2.50	[b]2.68	2.50	2.25
New Orleans	3.20	3.30	3.20	3.30	3.20	3.30	3.00	3.30	3.00	3.30	3.00	3.30
New York (delivered)	2.30	2.60 2.70	2.20 2.30	2.60 2.70	2.30	2.60 2.70	2.40	2.70 2.80	2.40	2.70 2.80	2.40 2.50	2.70 2.80
New York (alongside dock to dealers)	2.00	2.30	2.00	2.30	2.00	2.30	2.30	2.30	2.00	2.30	2.10	2.30
Peoria	2.14	2.26	2.13	2.26	1.98	2.41	2.08	2.41	2.08	2.41	2.18	2.41
Philadelphia	2.23	2.51	2.21	2.41	2.21	2.41	2.21	2.41	2.21	2.41	2.21	2.41
Pittsburgh	2.02	2.14	2.02	2.14	2.02	2.24	2.02	2.24	2.02	2.24	2.12	2.24
St. Louis	2.20	2.35	2.20	2.35	2.20	2.35	2.20	2.35	2.20	2.35	2.20	2.35
St. Paul	2.24	2.29	2.24	2.29	2.24	2.39	2.24	2.39	2.24	2.39	2.34	2.39
San Francisco	2.84	2.71	2.84	2.71	2.73	2.71	2.73	2.71	2.73	2.71	2.83	2.71
Seattle	3.10	2.90	2.94	2.90	2.94	2.90	2.94	2.90	2.94	2.90	2.94	2.90
Toledo	2.31	2.33	2.20	2.33	2.20	2.48	2.20	2.48	2.20	2.48	2.39	2.48

City	July		August		September		October		November		December	
	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923	1922	1923
Atlanta	$2.34	$2.85	$2.50	$2.85	$2.50	$3.00	$2.54	$3.00	$2.54	$2.60	$2.54	$2.35
Baltimore	2.50	2.65	2.50	2.65	2.50	2.65	2.90	2.65	2.90	2.65	2.90	2.61
Birmingham	2.10	2.70	2.10	2.70	2.10	2.70	2.40	2.70	2.40	2.80	2.40	2.80
Boston	2.50	2.80	2.50	2.90	------	2.90	------	2.78	------	2.90	2.85	2.92
Cedar Rapids	2.33	2.48	2.33	2.48	2.48	2.48	2.48	2.48	2.45	2.48	2.45	2.38
Chicago	2.05	2.20	2.05	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.10
Cincinnati	2.39	2.54	2.39	2.54	2.46	2.54	2.59	2.54	2.51	2.54	2.51	2.41
Cleveland	2.31	2.46	2.31	2.46	2.59	2.46	2.46	2.46	2.46	2.46	2.46	2.41
Dallas	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.05	2.25	2.05
Davenport	2.28	2.43	2.28	2.43	2.43	2.43	2.43	2.43	2.43	2.43	2.43	2.33
Denver	2.90	2.84	2.85	2.84	2.85	2.84	2.85	2.84	2.85	2.84	2.85	2.84
Detroit	2.33	2.48	2.33	2.48	2.48	2.48	2.48	2.48	2.47	2.48	2.47	2.37
Duluth	2.02	2.14	2.14	2.25	2.14	2.25	2.14	2.25	2.14	2.25	2.14	2.19
Indianapolis	2.26	2.41	2.26	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.31
Jersey City	2.28	2.48	2.28	2.48	2.73	2.48	2.73	2.48	2.73	2.48	2.48	2.33
Kansas City	2.40	2.45	2.40	2.55	2.85	2.90	2.85	2.45	2.85	------	2.45	2.27
Los Angeles	3.30	3.20	3.30	3.16	3.30	3.16	3.30	3.16	------	3.16	------	3.16
Milwaukee	2.22	2.37	2.22	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.25
Minneapolis	2.29	2.39	2.39	2.50	2.39	2.50	2.39	2.50	2.39	2.50	2.39	2.42
Montreal	2.88	2.25	2.78	2.25	2.78	2.25	2.78	2.25	2.88	2.25	2.88	2.25
New Orleans	3.20	3.30	3.20	3.30	3.20	2.90	3.30	2.90	3.30	2.90	3.30	2.80
New York (delivered)	2.40 2.50	2.70 2.80	2.40 2.50	2.70 2.80	2.60	2.70 2.80	2.60 2.75	2.70 2.80	2.60	2.70 2.80	2.60	2.55 2.65
New York (alongside dock to dealers)	2.10	2.30	2.10	2.30	2.30	2.30	2.55	2.30	2.30	2.30	2.30	2.15
Peoria	2.26	2.41	2.26	2.41	2.41	2.41	2.41	2.41	2.39	2.41	2.39	2.27
Philadelphia	2.31	------	2.31	------	2.41	2.75	2.41	2.96	2.51	2.96	2.51	2.81
Pittsburgh	2.09	2.24	2.09	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.24	2.19
St. Louis	2.20	2.35	2.20	2.35	2.20	2.45	2.35	2.45	2.35	2.45	2.35	2.35
St. Paul	2.29	2.39	2.39	2.50	2.39	2.50	2.39	2.50	2.39	2.50	2.39	2.42
San Francisco	2.63	2.71	2.71	2.63	2.71	2.63	2.71	2.63	2.71	2.61	2.71	2.61
Seattle	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
Toledo	2.33	2.48	2.33	2.48	2.53	2.48	2.53	2.48	2.48	2.48	2.48	2.48

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[a] Prices quoted are f. o. b. points listed, without bags; cash discount not deducted.
[b] Delivered.

MANUFACTURING CONDITIONS

PLANTS

Portland cement was made at 126 plants in 1923, compared with 118 in 1922. Eight new plants produced Portland cement in 1923. These are equipped (at the end of 1923) as follows:

Phoenix Portland Cement Co., plant near North Birmingham, Jefferson County, Ala. Dry process; limestone and shale; clinker burned with coal; three 10 by 150 foot kilns; reported daily clinker capacity, 4,000 barrels.

Lehigh Portland Cement Co., plant at Tarrant City (near North Birmingham), Jefferson County, Ala. Wet process; limestone and clay; clinker burned with coal; three 10 to 11¼ by 190 foot kilns; reported daily clinker capacity, 2,900 barrels.

Pyramid Portland Cement Co., plant at Valley Junction, Polk County, Iowa. Wet process; limestone and shale; clinker burned with coal; two 10 to 11¼ by 240 foot kilns; reported daily clinker capacity, 2,400 barrels.

New Egyptian Portland Cement Co., plant at Port Huron, St. Clair County, Mich. Wet process; limestone and clay; clinker burned with coal; one 11¼ by 200 foot kiln; reported daily clinker capacity 1,600 barrels.

Aetna Portland Cement Co., plant at Bay City, Bay County, Mich. Dry process; limestone, clay, and shale; clinker burned with coal; one 10 by 200 foot kiln; reported daily clinker capacity, 1,250 barrels.

Sandusky Cement Co., plant at Silica, Lucas County, Ohio. Wet process; limestone, clay, cement rock, and shale; clinker burned with coal; three 10 by 150 foot kilns; reported daily clinker capacity, 3,300 barrels.

Sun Portland Cement Co., plant at Lime, Baker County, Oreg. Wet process; limestone and shale; clinker burned with oil; one 9 to 10 by 210 foot kiln; reported daily clinker capacity, 1,200 barrels.

Signal Mountain Portland Cement Co., plant at North Chattanooga, Hamilton County, Tenn. Wet process; limestone and clay; clinker burned with coal; two 11 by 175 foot kilns; reported daily clinker capacity, 3,000 barrels.

Additional plants were under construction but not completed in 1923 in California, Michigan, Ohio, South Dakota, Tennessee, Texas, and Wisconsin. Several of them will report production in 1924.

KILNS AND FUELS

The total number of rotary kilns reported in plants that operated in 1923 was 793, compared with 760 in 1922. Recent studies by conservation engineers have indicated that the diameter of rotary kilns should be considered as well as the length. Some mills have increased the diameter of the lower end of the kiln, in the belief that this would result in an increase in the output of clinker.

As to kiln fuels the records of 1923 show that 78.7 per cent of the Portland cement produced was burned with coal alone, compared with 75.7 per cent in 1922. The percentage burned with crude oil increased slightly—in fact, the increase in the production of cement in California, where oil only is used, was over 10 per cent of the entire increase in production of cement in the United States in 1923.

Portland cement burned by different fuels in 1922 and 1923

Fuel	1922				1923			
	Number of plants	Number of kilns	Barrels of cement	Percentage of total	Number of plants	Number of kilns	Barrels of cement	Percentage of total
Coal	90	590	86,864,274	75.7	101	641	108,272,858	78.7
Coal and crude oil	7	64	12,030,542	10.5	1	24	8,091,506	5.9
Coal and natural gas	1	6			------	------		
Crude oil and natural gas	------	------	------	------	2	9		
Crude oil	17	85	12,794,890	11.1	18	95	16,313,410	11.9
Crude oil, coal, and natural gas	2	8	3,100,278	2.7	3	18	4,782,464	3.5
Natural gas	1	7			1	6		
	118	760	114,789,984	100.0	126	793	137,460,238	100.0

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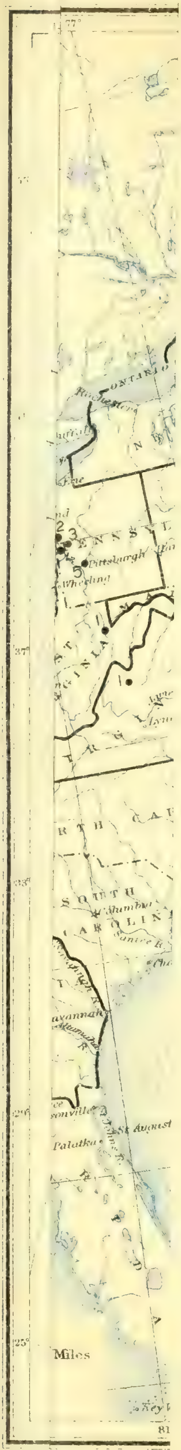

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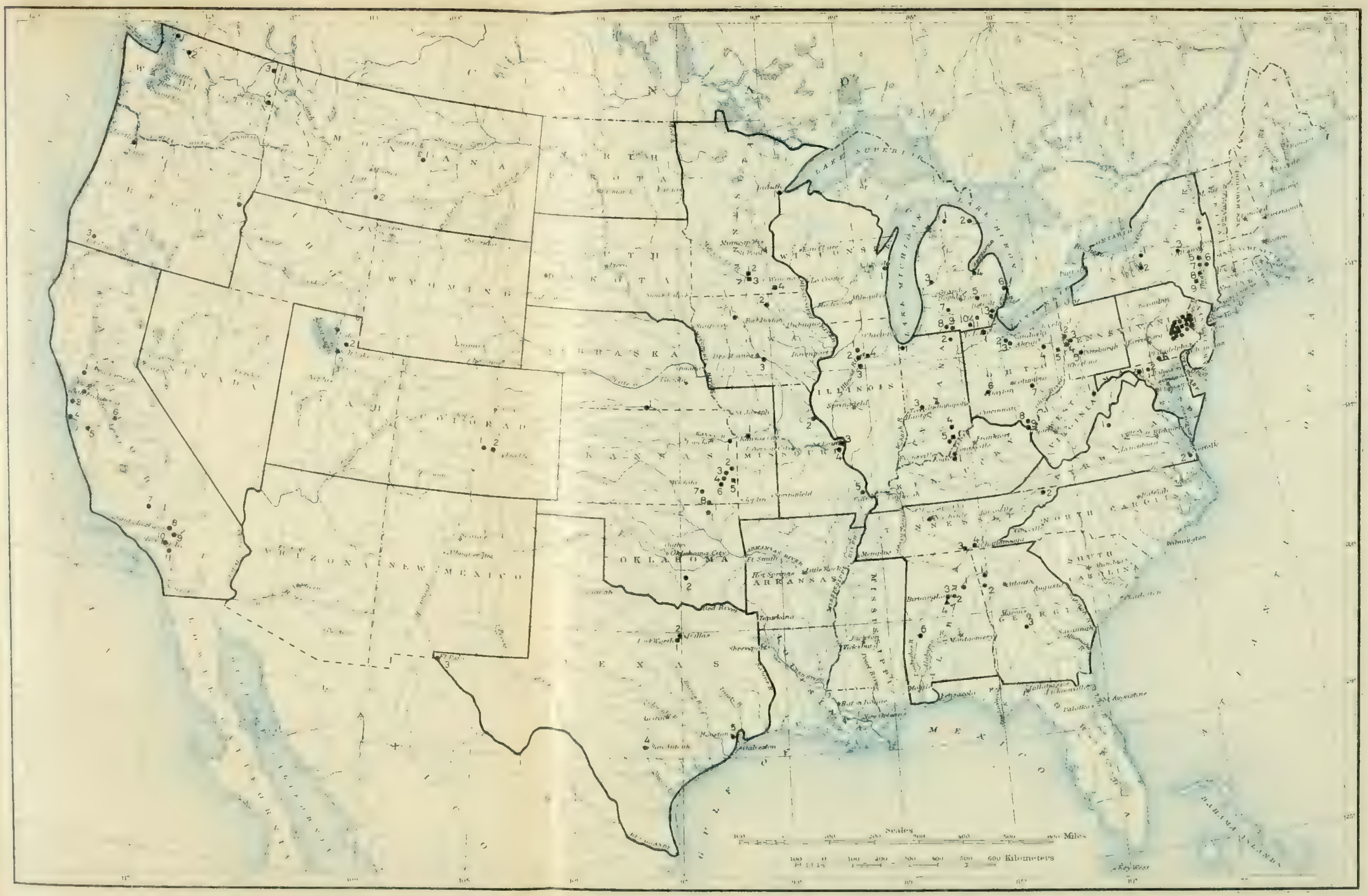

CEMENT PLANTS

(PORTLAND CEMENT UNLESS OTHERWISE SPECIFIED
N = NATURAL CEMENT PZ = PUZZOLAN CEMENT)
* UNDER CONSTRUCTION

NAME AND LOCATION

ALABAMA

1 NATIONAL RAGLAND
2 ATLAS LEEDS
3 { LEHIGH
  PHOENIX } NORTH BIRMINGHAM
4 SOUTHERN (PZ) NORTH BIRMINGHAM
5 GULF STATES SPOCARI

CALIFORNIA

1 PACIFIC CEMENT
2 COWELL COWELL
3 PACIFIC REDWOOD CITY
4 SANTA CRUZ DAVENPORT
5 OLD MISSION SAN JUAN BAUTISTA
6 *YOSEMITE MERCED
7 MONOLITH MONOLITH
8 SOUTHWESTERN VICTORVILLE
9 GOLDEN STATE OROGRANDE
10 CALIFORNIA, COLTON
11 RIVERSIDE RIVERSIDE

COLORADO

1 COLORADO PORTLAND
2 UNITED STATES, CONCRETE

GEORGIA

1 GEORGIA CEMENT & STONE PORTLAND
2 SOUTHERN STATES ROCKMART
3 *CLINCHFIELD COREEN

ILLINOIS

1 SANDUSKY DIXON
2 { ALPHA
  MARQUETTE } LA SALLE
3 LEHIGH OGLESBY
4 UTICA (N), UTICA

INDIANA

1 UNIVERSAL BUFFINGTON
2 WABASH STROH
3 INDIANA GREENCASTLE
4 LEHIGH MITCHELL
5 LOUISVILLE (ALSO N) SPEED

IOWA

1 GILMORE GILMORE CITY
2 { LEHIGH
  NORTHWESTERN STATES } MASON CITY
3 { HAWKEYE DES MOINES
  PYRAMID VALLEY JUNCTION }

KANSAS

1 KANSAS BONNER SPRINGS
2 GREAT WESTERN, MILDRED
3 LEHIGH IOLA
4 MONARCH HUMBOLDT
5 FORT SCOTT (N) FORT SCOTT
6 ASH GROVE CHANUTE
7 FREDONIA FREDONIA
8 ATLAS INDEPENDENCE

KENTUCKY

1 KOSMOS (ALSO N) KOSMOSDALE

MARYLAND

1 SECURITY SECURITY
2 TIDEWATER UNION BRIDGE

MICHIGAN

1. PETOSKEY PETOSKEY
2 HURON ALPENA
3 NEWAYGO NEWAYGO
4 AETNA BAY CITY
5 { AETNA
  NEW EGYPTIAN } FENTON
6 NEW EGYPTIAN PORT HURON
7 ALPHA BELLEVUE
8 PEERLESS UNION CITY
9 WOLVERINE COLDWATER AND QUINCY
10 PENINSULAR CEMENT CITY
11 MICHIGAN CHELSEA
12 WYANDOTTE WYANDOTTE
13 { FORD
  *PEERLESS } RIVER ROUGE

MINNESOTA

1 UNIVERSAL MORGAN PARK
2 CARNEY (N) CARNEY
3 CARNEY (N) MANKATO
4 AUSTIN (N) AUSTIN

MISSOURI

1 MISSOURI SUGAR CREEK
2 ATLAS HANNIBAL
3 MISSOURI PROSPECT HILL
4 ALPHA ST LOUIS
5 MARQUETTE CAPE GIRARDEAU

NAME AND LOCATION

MONTANA

1 THREE FORKS HANOVER
2 THREE FORKS, TRIDENT

NEBRASKA

1 NEBRASKA SUPERIOR

NEW JERSEY

1 { VULCANITE VULCANITE
  EDISON NEW VILLAGE
  ALPHA, ALPHA } LEHIGH DISTRICT

NEW YORK

1 ALPHA JAMESVILLE
2 CAYUGA PORTLAND POINT
3 HELDERBERG HOWES CAVE
4 GLENS FALLS GLENS FALLS
5 ACME CATSKILL
6 { KNICKERBOCKER
  ATLAS } HUDSON
7 HUDSON VALLEY ALSEN
8 ALPHA CEMENTON
9 SNYDER (N) ROSENDALE

OHIO

1 SANDUSKY SILICA
2 SANDUSKY BAYBRIDGE
3 CASTALIA CASTALIA
4 DIAMOND MIDDLE BRANCH
5 LISBON (N) LISBON
6 *SOUTHWESTERN, OSBORN
7 PITTSBURG PLATE GLASS FULTONHAM
8 WELLSTON SUPERIOR
9 ALPHA IRONTON

OKLAHOMA

1 DEWEY DEWEY
2 OKLAHOMA ADA

OREGON

1 OREGON OSWEGO
2 SUN LIME
3 BEAVER GOLD HILL

PENNSYLVANIA

1 { ALLENTOWN EVANSVILLE
  ALPHA MARTINS CREEK
  ATLAS COPLAY AND NORTHAMPTON
  BATH BATH
  COPLAY COPLAY
  DEXTER NAZARETH
  GIANT EGYPT AND LESLEY
  HERCULES STOCKERTOWN
  LAWRENCE (ALSO N) SIEGFRIED
  LEHIGH FOGELSVILLE ORMROD AND WEST COPLAY
  NAZARETH NAZARETH
  PENN ALLEN PENN ALLEN
  PENNSYLVANIA BATH
  PHOENIX NAZARETH
  WHITEHALL CEMENTON } LEHIGH DISTRICT
2 BESSEMER BESSEMER
3 LEHIGH NEWCASTLE
4 CRESCENT WAMPUM
5 UNIVERSAL UNIVERSAL
6 SANDUSKY YORK

SOUTH DAKOTA

1 SOUTH DAKOTA STATE RAPID CITY

TENNESSEE

1 HERMITAGE NASHVILLE
2 CLINCHFIELD KINGSPORT
3 DIXIE RICHARD CITY
4 SIGNAL MOUNTAIN CHATTANOOGA

TEXAS

1 *TRINITY FORT WORTH
2 { TRINITY EAGLE FORD
  TEXAS CEMENT }
3 SOUTHWESTERN EL PASO
4 SAN ANTONIO SAN ANTONIO
5 TEXAS MANCHESTER

UTAH

1 OGDEN BAKERS
2 UNION DEVILS SLIDE
3 UTAH SALT LAKE CITY

VIRGINIA

1 LEHIGH FORDWICK
2 *VIRGINIA NORFOLK

WASHINGTON

1 OLYMPIC BELLINGHAM
2 SUPERIOR CONCRETE
3 LEHIGH METALINE FALLS
4 INTERNATIONAL IRVIN

WEST VIRGINIA

1 ALPHA MANHEIM

WISCONSIN

1 MANITOWOC, MANITOWOC

MAP OF UNITED STATES SHOWING DISTRIBUTION OF PORTLAND, NATURAL, AND PUZZOLAN CEMENT PLANTS AND OUTLINES OF COMMERCIAL DISTRICTS

Prepared by Ernest F. Burchard
1924

● Portland cement plant ■ Natural cement plant ▲ Puzzolan cement plant

ENGINEER REPRODUCTION PLANT U S ARMY WASHINGTON BARRACKS D C 5637
1924

The utilization of the heat in the gases escaping from rotary kilns to generate steam with which to operate the machinery of the plant is regarded by the conservation engineer of the Portland Cement Association as probably the greatest improvement in equipment of Portland cement factories in recent years.[4] It is only during the last six years that Portland cement manufacturers have been installing waste-heat boilers to any noteworthy extent, although the movement dates back to 1897, when an attempt was made at a mill near Nazareth, Pa., to heat the boilers partly by means of kiln gases. Other tests followed at Portland Point, N. Y. The principal difficulties in the early attempts were caused by kiln dust clogging the boiler flues and by air leakage, and lack of appreciation of the importance of regulation and control of draft delayed the attainment of satisfactory results. At present dust may be removed by several different methods, and air is excluded at all possible points of entry by seals and air-tight joints. With intensive studies of the problem have come changes in boiler design and the exercise of scientific control in the handling of the entire system. The waste gases are analyzed at regular intervals, hourly readings of the draft at different points are recorded, steam and water flow meters show the quantity of water used, and pyrometers and recording thermometers record the temperatures of the gas, water, and steam throughout the system. According to Shaffer,

> That intelligent regulation and control is a paying proposition from the front end of the kiln to the fan after the economizers has been clearly demonstrated in many modern Portland-cement plants. Probably the one outstanding feature in the development of the waste-heat boiler in the cement industry is the fact that quite a number of plants are now producing all of the power required to operate their entire plants in waste-heat boilers. This condition prevails not alone in the dry process but during the past year has been shown possible in the wet process of manufacture.
>
> It should be stated, however, that the ability to develop 100 per cent of the power required to operate any cement plant depends largely on the character of the prime movers and to fairly low kilowatt-hours per barrel consumption in the various mill departments. Some of the older plants with old-style reciprocating engines or high steam consuming turbines are obliged to operate some auxiliary boilers in addition to their waste-heat equipment. There are, however, plants of later design with low steam consuming prime movers and a satisfactory consumption of power in the raw and clinker-grinding departments, which are experiencing no trouble at all in generating 100 per cent of their power requirements. It should be borne in mind, however, that in order to effect these savings, which amount to from 30 to 50 pounds of coal per barrel of cement manufactured, large sums of money must be added to the already high investment. As an example, depending upon the size of the cement plant, the cost of the equipment of a modern waste-heat plant will vary from $250,000 to $700,000. There are now 30 Portland-cement factories with waste-heat boilers installed. Many other companies have plans under consideration which call for this improvement; undoubtedly the high cost of construction and equipment is causing delay on the part of some companies. However, they all recognize the importance of conserving the heat in the waste gases from their rotary kilns.

CAPACITY

The total annual manufacturing capacity of all the active plants at the end of 1923, according to manufacturers' reports, a few of which have been revised slightly for the sake of consistency, and a few estimates, was 161,858,000 barrels, an increase of over 10.7 per cent.

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[4] Shaffer, H. A., Waste heat from cement kilns operates entire mill: Chem. and Met. Eng., July 2, 1923, pp. 18–19.

This includes the annual capacity of eight new plants completed during the year, amounting to about 5,830,000 barrels of finished Portland cement. According to these figures the total production of Portland cement in 1923 was 84.9 per cent of the total capacity, whereas the production in 1922 represented 78.5 per cent of the apparent total capacity in that year. It is very difficult to arrive at a true approximation of the cement-manufacturing capacity of the country. Some manufacturers report varying totals from year to year, although the same equipment is indicated. For 1923 four concerns reported a capacity less than their production for the year, but due allowance was made for this oversight in the present estimates. The record production for one month during 1923 was reached in October, when 13,350,000 barrels was made, or 98 per cent of the monthly capacity based on the annual capacity stated above. At this rate 160,200,000 barrels would be produced in a year, but in all probability the mills of the country could not sustain so great a productivity for so long a period, even under the most favorable operating conditions and liveliest demand for cement, and therefore it appears as if the capacity stated above for 1923 may be slightly excessive.

Portland cement manufacturing capacity of the United States, by commercial districts, 1922 and 1923

District	Estimated capacity (barrels)		Percentage of capacity utilized	
	1922	1923	1922	1923
Eastern Pennsylvania, New Jersey, and Maryland	41, 921, 000	42, 195, 000	74. 4	84. 7
New York	8, 567, 000	8, 306, 000	69. 1	84. 2
Ohio, western Pennsylvania, and West Virginia	12, 133, 000	15, 090, 000	88. 6	89. 4
Michigan	7, 930, 000	9, 346, 000	78. 7	81. 5
Illinois, Indiana, and Kentucky	21, 550, 000	22, 296, 000	83. 5	95. 1
Virginia, Tennessee, Alabama, and Georgia	7, 113, 000	10, 719, 000	83. 7	73. 8
Eastern Missouri, Iowa, and Minnesota	14, 177, 000	16, 580, 000	80. 4	84. 7
Western Missouri, Nebraska, Kansas, and Oklahoma	10, 215, 000	11, 795, 000	78. 6	82. 9
Texas	4, 425, 000	4, 642, 000	82. 0	90. 0
Colorado and Utah	2, 850, 000	3, 025, 000	70. 9	80. 3
California	10, 464, 000	12, 594, 000	83. 3	87. 4
Oregon, Washington, and Montana	4, 858, 000	5, 270, 000	60. 6	58. 9
	146, 203, 000	161, 858, 000	78. 5	84. 9

ALUMINA CEMENT

Since the World War there has been a steadily increasing interest in the United States in a type of cement which since 1908 has been in use in France and which, on account of certain properties, was of especial value to the French Army for rapid work on gun emplacements and roads. This type of cement is characterized by its high alumina content in comparison with that of ordinary Portland cement and has been designated in recent technical literature chiefly by the term "alumina cement," which is a convenient general name. The original basic French patent for the manufacture of alumina cement was issued to J. & A. Pavin de Lafarge in 1908, and since then alumina cement has been marketed in France under the trade names "alciment," "ciment fondu" (fused cement), and "ciment électrique." The fused cement is made from a mixture of limestone and bauxite fused in a blast furnace or an electric furnace.[5]

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[5] Eckel, E. C., Cements, limes, and plasters, 2d ed., p. 517, New York, John Wiley & Sons, 1922.

Credit for the development of the alumina-cement industry in France is given to M. Jules Bied, the chemical director of the Lafarge Co., by Henry S. Spackman,[6] the American discoverer and patentee of "aluminate" cement. Spackman refers to the genesis of alumina cements as the story of two investigators, widely separated, each ignorant of the other's work and each starting with a slightly different aim in view but reaching in the end the same conclusion and results. Bied's specific object was to find a low-lime hydraulic cement that would be resistant to the attack of sea water. Spackman's object was to develop a cement that would be quicker to harden, stronger, and more durable under ordinary conditions than Portland cement. In alumina cement both investigators found their desire realized. At first it was the resistance of alumina cement to sea water rather than its high strength at early periods that led to the development of the alumina-cement industry in France. The use of this type of cement for artillery foundations in France during the war appears to have suggested that the advantages of rapid hardening and early strength would be equally valuable in general construction work.

Letters patent on "aluminous cementitious material" were issued by the United States Patent Office to Henry S. Spackman and Ellis W. Lazell June 18, 1912. These were assigned to Henry S. Spackman and recently were acquired by the Atlas Aluminate Cement Co., which in 1924 changed its name to the Atlas Lumnite Cement Co. No production of this type of cement in the United States was reported for 1923, but it is on the market in 1924.

The following statement by one of the first American engineers to become acquainted with the use of alumina cements in France [7] covers the ground in so clear and nontechnical a fashion that it is quoted in full:

> Portland cement has now been in use as our leading artificial structural material for almost exactly 100 years, and for many purposes it is likely to continue in use for many decades longer. But for certain special uses, and among these certain very important uses, it now seems likely to be replaced by one of the newer types of cement, made specially to satisfy special requirements. The new cements here referred to are the alumina cements, a term which I have applied in order to avoid using specific brand names and which seems likely now to be adopted officially when the new cement is placed on the American market next spring.
>
> The alumina cements are strictly "new" only in the sense that they are novelties to the American engineer; they have as a matter of fact been made and used for some 15 years in France and elsewhere in Europe; and they have established a certain definite success along certain definite lines. Their replacement of Portland cement for such special uses is not based on competition in price, for the alumina cements are dearer than Portland, but on superiority in quality for the particular uses to which they are put.
>
> Alumina cements have two valuable technical properties. They are, first of all, particularly resistant to chemical attack and have been used successfully in sea water and in grounds soaked with alkaline waters, where ordinary Portland cements had failed. Their second important technical property is the quickness with which they attain their total strength; a concrete made with alumina cement will give in a day or two tensile and compressive tests equal to those given by a Portland concrete a month old. All of these facts have been thoroughly established during some 15 years' experience in Europe, and they are not stated as arguments but merely as summaries of current engineering knowledge of the alumina cements.
>
> As to technical details, the alumina cements differ markedly from Portland cement in their raw materials and in their manufacture. So far as the first

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[6] Spackman, H. S., What we may expect to do with aluminate cement: Concrete, March, 1924, pp. 88-90.

[7] Eckel, E. C., The new alumina cements: Manufacturers Record, Nov. 1, 1923, p. 87.

point is concerned, they use limestone and bauxite as raw materials—a point which is of particular interest to the South, where all of our known bauxite deposits are located. So far as manufacture is concerned, the alumina cements are commonly though not necessarily made by complete fusion in a furnace, rather than by clinkering in a rotary kiln, as are the Portlands. The reason for this difference in procedure is economic rather than technologic; with a mix high in alumina and low in lime it is easier to fuse completely than to semifuse or clinker; and if one intends to fuse a mix, the furnace is far cheaper than the rotary.

It is probable that the first heavy output of alumina cement in this country will be made this winter and next spring in one of the Northern States, because of market conditions. But so far as cheapness of manufacture is concerned, localities where limestone, bauxite, and coke can be assembled most cheaply will ultimately have the preference for coldly commercial reasons. It is therefore reasonable to assume that within a few years the South will have a far larger proportion of this new industry than it has of the existing Portland cement industry.

The limitations on the cement, as suggested above, will arise, if at all, not from technical considerations but from high-cost raw materials. At present the cheapest sources of such materials are the lower-grade bauxites, for which no market has hitherto been available; but it is by no means certain that this dependence on a bauxite supply will continue for many years longer. Investigations now in progress on a very large scale—also, it may be noted, in a Southern State—suggest that we may be on the verge of securing a far cheaper source of alumina than bauxite, not only for the alumina-cement industry but for other purposes.

The characteristics of alumina cements are briefly summarized by Bied[8] as follows:

> Composition of the finished product is approximately SiO_2, 12 per cent; Al_2O_3, 40 to 60 per cent; CaO, less than 40 per cent; Fe_2O_3, 10 per cent. The particular value of these cements is their resistance to salt and sulphate waters and their quick-setting properties. The set begins in about four hours and is completed in seven to eight hours. It is possible to remove forms 24 hours after pouring, and the resistance to compression at that period is four times that of Portland cement.

The Bureau of Standards[9] has studied these cements and summarized the results as follows:

> There have been produced in a rotary kiln certain cements, characterized by a high alumina content, which have the property of hardening in a short time to such a degree as to give very high strengths. This is especially true when the cements are used in mortars or concrete.
>
> The temperatures necessary for burning the raw mixes and the actions of these in the kiln were little if at all different from those observed in the burning of Portland cement.
>
> The raw materials used were limestone and calcined alumina; in some cases the effects of such impurities as silica and iron oxide were studied by the use of kaolin, bauxite, or flint, in addition to the above.
>
> The ground clinker in some cases set very rapidly, but in other cases where the alumina was very high it set slowly.
>
> The hardening was very rapid in all cases unless the content of impurities became very high, when the hardening resembled more closely that of Portland cement.
>
> The predominant constituent noted in the clinker was the monocalcium aluminate or the 3:5 calcium aluminate. As the silica increased, increasing amounts of the orthosilicate of lime or the ternary compound $2CaO.SiO_2.Al_2O_3$ were noted.
>
> The products of hydration were hydrated tricalcium aluminate and hydrated alumina resulting from the aluminates, and hydrated lime from the orthosilicate of lime, leaving the latter in a hydrated form but of a lower lime content than that required to form $2CaO.SiO_2$.
>
> The early hardenings were due to the rapidity with which the aluminates hydrate. The high strengths were due to the thoroughness of the hydration and to the fact that this was largely colloidal.

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[8] Bied, J., The cements of high alumina tenor: Jour. du four électrique, 32d year, No. 2, p. 13, 1923.

[9] Bates, P. H., Cementing qualities of the calcium aluminates: U. S. Bur. Standards Tech. Paper 197, pp. 26–27, 1921.

The methods of storage of the test pieces showed that these cements had their strengths rather materially reduced by the absorption of moisture. This was due to the large amount of colloidal products of hydration, which are very susceptible to moisture changes. They would therefore not be satisfactory for use when subjected to the action of water.

The cost of the raw materials at the present time is such as to preclude the commercial use of these cements except under very special cases, They are of much interest, however, in showing that besides the high-limed silica compounds there is another group of compounds in the lime-alumina-silica system which has cementing qualities. This investigation showed, however, that these two groups are the only ones of this character in the system.

If the manufacture of alumina cement in the United States reaches large proportions the question of supplies of bauxite will become important. At present, with manufacture of the cement confined to the East, within easy reach of the Atlantic seaboard, high-grade bauxite imported from France or South America may be available, but a time will undoubtedly come when it may be desirable to turn to domestic bauxite and possibly to accept lower grades of material. In discussing some newly discovered deposits of this mineral in Mississippi a Geological Survey report [10] states:

> In addition to the current metallurgical, chemical, refractory, and abrasive uses for bauxite, a new use in the manufacture of alumina cement, a quick-setting hydraulic cement now used to a large extent in France and soon to be manufactured in the United States, seems an interesting possibility.

Readers who desire to consult other articles on the subject of alumina cement are referred to the following papers:

Eckel, E. C., Alumina cement in France: Eng. News-Record, Aug. 30, 1923, pp. 347–349.

Eckel, E. C., Alumina cements and silica cements: Cement, Mill, and Quarry, June 20, 1924, p. 24.

Eckel, E. C., Portland cement and related cements: Cement, Mill, and Quarry, July 20, 1924, pp. 23–24.

Anon., Results obtained in France with aluminate cement: Cement, Mill, and Quarry, Mar. 5, 1924, p. 25.

Anon., Alumina cement—its development, use, and manufacture: Rock Products, Aug. 12, 1922, pp. 30–32.

MASONRY, NATURAL, AND PUZZOLAN CEMENTS

The term "masonry cement" has been introduced here for certain cements, made by grinding calcined calcareous rock, like natural cements, that are being used very largely in mortar for laying brick and stone, although of course other hydraulic cements are also suitable for masonry work.

Natural cement, including masonry cement, was produced in 1923 in 9 plants, distributed in 8 States—near Rosendale, N. Y.; Siegfried, Pa.; Lisbon, Ohio; Speeds, Ind.; Utica, Ill.; Fort Scott, Kans.; Kosmosdale, Ky.; and Austin and Mankato, Minn.

One manufacturer with a plant at Birmingham, Ala., reports an output of puzzolan or slag-lime cement, and in order that this quantity may be included in the cement totals for the United States without revealing confidential information it is included with the statistics of masonry and natural cements.

The next table, which gives such statistics as may be presented concerning the output of masonry, natural, and puzzolan cements in 1922 and 1923, indicates an increase in quantity of about 43 per cent and in value of more than 50 per cent as compared with the output in 1922. The average factory value per barrel in 1923 was $1.53, compared with $1.45 in 1922. The output has been expressed in terms of 376-pound barrels, to correspond with the statistics for Portland cement.

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[10] Burchard, E. F., Bauxite in northeastern Mississippi: U. S. Geol. Survey Bull. 750–G, p. 145, 1924.

The second table presents quoted wholesale prices of these cements in lots of 500 barrels or more, exclusive of bags, f. o. b. at six widely separated cities in the United States, as published by the Engineering News-Record, but in order to make a consistent comparison of these prices it must be taken into consideration that weights per barrel of 240, 265, 320, and 380 pounds are involved instead of the standard for Portland cement, which is 376 pounds. These cements are packed four sacks to the barrel, each sack holding about 1 cubic foot, as with Portland cement, but the lighter specific gravity of the non-Portland cements accounts for their smaller weight per barrel.

Masonry, natural, and puzzolan cement shipped, 1922 and 1923

State	1922			1923		
	Producing plants	Barrels of 376 pounds	Value	Producing plants	Barrels of 376 pounds	Value
Alabama [a]	1	497,081	$798,434	1	684,563	$1,137,585
Illinois	1			1		
Indiana	1			1		
Kansas	1	392,347	495,164	1	587,111	809,767
Kentucky [b]	--------			1		
Minnesota	2			2		
New York	1			1		
Ohio	1			1		
Pennsylvania	1			1		
	9	889,428	1,293,598	10	1,271,674	1,947,352

[a] Puzzolan only.
[b] No shipments reported for 1922.

Wholesale prices[a] of masonry, natural, and puzzolan cements, 1922 and 1923, by months

[Per barrel[b] except as otherwise noted]

City and brand	January		February		March		April	
	1922	1923	1922	1923	1922	1923	1922	1923
Atlanta (Magnolia)[c]	$11.00	$11.00	$11.00	$11.00	$11.00	$11.00	$11.00	$11.00
Boston (Rosendale)	[d].85 [d].95	--------	[d].85 [d].95	--------	[d].85	2.60	[d].80	2.60
Cincinnati (Utica)	1.93	1.72	1.93	1.72	1.93	1.72	1.77	1.72
Kansas City (Fort Scott)	1.60	1.50	1.60	1.50	1.60	1.50	1.60	1.50
Minneapolis (Rosendale)	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
St. Louis (Carney)	--------	1.75	--------	1.75	--------	1.75	--------	1.75
St. Louis (Carney hydrated)	--------	--------	--------	--------	--------	--------	--------	--------

[a] Price to dealers per barrel for 500 barrels or more, f. o. b., exclusive of bags; unless otherwise designated.
[b] Available information indicates that the weights per barrel of these cements are as follows: Rosendale, 300 pounds; Utica, 265 pounds; Fort Scott, 240 pounds; Carney, 240 pounds; Magnolia (puzzolan cement), 380 pounds.
[c] Per ton.
[d] Per bag.

Wholesale prices of masonry, natural, and puzzolan cements, 1922 and 1923, by months—Continued

City and brand	May		June		July		August	
	1922	1923	1922	1923	1922	1923	1922	1923
Atlanta (Magnolia)[c]	$11.00	$11.00	$11.00	$11.00	$11.00	--------	$11.00	--------
Birmingham (Magnolia)	--------	--------	--------	--------	--------	$2.10	--------	$2.10
Boston (Rosendale)	[d].80	2.60	[d].80	2.60	[d].80	2.70	[d].80	2.70
Cincinnati (Utica)	1.77	1.72	1.77	1.72	1.77	1.72	1.77	1.72
Kansas City (Fort Scott)	1.60	1.50	1.60	1.50	1.60	1.50	1.60	1.50
Minneapolis (Rosendale)	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
St. Louis (Carney)	--------	1.75	--------	2.85	--------	2.85	--------	2.35
St. Louis (Carney hydrated)	2.10	--------	2.10	--------	2.10	--------	2.10	--------

City and brand	September		October		November		December	
	1922	1923	1922	1923	1922	1923	1922	1923
Atlanta (Magnolia)[c]	$11.00	--------	$11.00	--------	$11.00	--------	$11.00	--------
Birmingham (Magnolia)	--------	$2.10	--------	$2.10	--------	$2.10	--------	$2.10
Boston (Rosendale)	--------	2.80	--------	2.80	--------	2.80	--------	2.80
Cincinnati (Utica)	1.77	1.72	1.72	1.72	1.72	1.72	1.72	1.72
Kansas City (Fort Scott)	1.60	1.50	1.75	1.75	1.75	--------	1.50	1.50
Minneapolis (Rosendale)	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80
St. Louis (Carney)	1.87	2.35	1.87	2.35	1.75	2.35	1.75	2.25
St. Louis (Carney hydrated)	--------	--------	--------	--------	--------	--------	--------	--------

[c] Per ton.
[d] Per bag.

FOREIGN TRADE IN CEMENT[11]

EXPORTS

In 1923 the hydraulic cement exported to foreign countries and to the Philippine Islands, most of it Portland cement, decreased about 11.2 per cent in quantity and about 8.2 per cent in value as compared with the exports of 1922. The quantity exported in 1923 was about 0.7 per cent of the total shipments of hydraulic cement in that year. The average value at the ports of export was $2.94 a barrel, as compared with $2.84 in 1922.

The exports were sent approximately as follows: To Cuba, 443,000 barrels; other West Indies, 80,000 barrels; South America, 257,000 barrels; Mexico, 101,000 barrels; Central America, 85,000 barrels; Canada, 14,000 barrels; and other countries, 22,000 barrels. The export trade varies from year to year but has never reached large proportions. In recent years strong competition from European manufacturers, whose labor costs are very much lower than those in the United States, has restricted the market for American cement in foreign countries. In Argentina late in 1922 the senior writer learned that Portland cement manufactured locally by American-owned mills was obliged to meet competition from more than 20 brands of cement, most of them European. In the same year raw Portland cement clinker was shipped to Brazil from a mill in the United States and ground into cement at the site where it was to be used.[12]

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[11] Statistics of exports and imports were compiled by J. A. Dorsey from records of the Bureau of Foreign and Domestic Commerce.

[12] Lesley, R. W., Cement: Mineral Industry, 1922, p. 96.

Hydraulic cement exported from the United States in 1922 and 1923, by countries

Destination	1922				1923	
	Portland[a]		Natural[a]		Barrels	Value
	Barrels	Value	Barrels	Value		
Argentina	23, 650	$122, 840	1, 401	$8, 880	36, 365	$214, 367
Azores and Madeira Islands	--------	--------	--------	--------	10	80
Belgium	128	855	--------	--------	60	748
Bermuda	2, 492	7, 627	--------	--------	3, 281	8, 975
Bolivia	4, 830	12, 586	--------	--------	4, 115	10, 712
Brazil	42, 139	130, 238	1, 269	8, 196	6, 402	37, 330
British East Indies:						
British India	25	185	--------	--------	611	3, 934
Straits Settlements	390	2, 470	--------	--------	477	2, 770
Other	--------	--------	--------	--------	125	700
British Guiana	--------	--------	--------	--------	45	329
British Honduras	4, 321	11, 268	--------	--------	33	122
British Oceania:						
Australia	138	902	242	1, 798	1, 433	9, 420
New Zealand	529	3, 566	510	3, 417	807	5, 379
Other	335	1, 106	--------	--------	50	184
British South Africa	265	1, 788	--------	--------	211	1, 489
British West Indies:						
Barbados	5	19	--------	--------	7	46
Jamaica	4, 388	11, 981	1	10	2, 209	5, 559
Trinidad and Tobago	3, 618	9, 666	--------	--------	1, 711	4, 826
Other	25, 511	64, 886	455	2, 241	24, 942	65, 018
Canada:						
Maritime Provinces	11, 332	24, 774	55	401	211	765
Quebec and Ontario	15, 910	52, 598	759	4, 927	12, 306	56, 226
Prairie Provinces	924	2, 902	--------	--------	750	4, 864
British Colombia	250	1, 533	29	236	718	5, 369
Canary Islands	1, 840	5, 726	--------	--------	15	107
Ceylon	10	76	--------	--------	30	147
Chile	14, 350	41, 290	262	1, 793	6, 868	27, 468
China	1, 140	7, 506	--------	--------	2, 110	12, 939
Colombia	104, 709	295, 270	456	1, 597	79, 710	203, 431
Costa Rica	4, 654	13, 953	55	408	3, 486	10, 576
Cuba	453, 250	1, 151, 059	2, 791	17, 684	442, 897	1, 119, 497
Dominican Republic	28, 880	76, 949	51	339	35, 042	87, 648
Dutch East Indies (other)	--------	--------	--------	--------	225	608
Dutch Guiana	--------	--------	--------	--------	500	1, 265
Dutch West Indies	1, 488	4, 675	--------	--------	1, 394	3, 971
Ecuador	4, 984	16, 503	--------	--------	14, 413	38, 562
Egypt	6	51	--------	--------	--------	--------
England	4, 187	26, 236	1, 488	7, 884	8, 824	56, 372
France	57	157	--------	--------	202	1, 430
French Guiana	1, 475	3, 967	330	875	990	2, 637
French Oceania	1, 405	5, 046	--------	--------	667	2, 269
French West Indies	2, 805	8, 339	--------	--------	--------	--------
Germany	--------	--------	--------	--------	12	91
Greece	50	375	--------	--------	75	561
Guatemala	4, 620	16, 134	7	24	6, 948	20, 686
Haiti	4, 445	10, 679	--------	--------	10, 876	26, 048
Honduras	27, 700	79, 806	171	734	39, 017	108, 741
Hongkong	73	539	--------	--------	230	1, 561
Iceland and Faroe Islands	--------	--------	16	86	--------	--------
Ireland	75	554	80	570	25	185
Italy	--------	--------	--------	--------	10	73
Japan	82	298	--------	--------	388	2, 440
Java and Madura	1, 455	9, 317	100	668	715	4, 576
Liberia	17	98	--------	--------	--------	--------
Lithuania	--------	--------	--------	--------	2, 000	5, 190
Mexico	100, 378	317, 111	2, 299	12, 864	101, 478	333, 061
Miquelon, Langley, and St. Pierre islands	660	1, 282	--------	--------	--------	--------
Netherlands	3	15	--------	--------	110	732
Newfoundland and Labrador	449	1, 389	10	74	477	1, 403
Nicaragua	5, 836	19, 227	--------	--------	4, 168	14, 107
Norway	60	469	30	240	103	671
Palestine and Syria	125	800	--------	--------	--------	--------
Panama	55, 833	141, 124	--------	--------	23, 028	59, 653
Peru	93, 250	231, 813	225	1, 437	70, 949	178, 469
Philippine Islands	5, 063	14, 406	320	2, 652	168	1, 275
Portugal	--------	--------	--------	--------	2	19
Portuguese East Africa	29	87	--------	--------	39	455
Portuguese Africa, other	86	425	--------	--------	123	419
Russia in Asia	1	14	--------	--------	--------	--------
Salvador	9, 418	31, 816	25	160	7, 973	29, 044
Scotland	4	28	--------	--------	475	3, 157
Siam	200	1, 352	--------	--------	--------	--------
Spain	321	2, 080	875	2, 665	1, 322	7, 335
Uruguay	4, 681	30, 060	200	1, 294	9, 220	56, 317
Venezuela	31, 392	87, 421	295	1, 747	27, 364	79, 322
Virgin Islands of the United States	310	975	2	13	141	444
	1, 113, 036	3, 120, 287	14, 809	85, 914	1, 001, 688	2, 944, 174

[a] Not separately classified in 1923.

Domestic hydraulic cement shipped to Alaska, Hawaii, and Porto Rico in 1922 and 1923

	1922		1923	
	Barrels	Value	Barrels	Value
Alaska	20, 345	$74, 950	10, 131	$41, 511
Hawaii	201, 353	609, 330	178, 882	544, 148
Porto Rico	125, 418	323, 338	99, 275	250, 844
	347, 116	1, 007, 618	288, 288	836, 503

Hydraulic cement exported from the United States, 1918–1923

Year	Barrels	Value	Percentage of total shipments	Year	Barrels	Value	Percentage of total shipments
1918	2, 252, 446	$5, 912, 166	3. 2	1921	1, 181, 014	$4, 276, 986	1. 2
1919	2, 463, 573	7, 513, 389	2. 9	1922	1, 127, 845	3, 206, 201	1. 0
1920	2, 985, 807	10, 045, 369	3. 1	1923	1, 001, 688	2, 944, 174	. 7

IMPORTS

The quantities given in the following table of imports include hydraulic cement of all kinds. Some of the cement imported evidently was not manufactured in the country from which it came to the United States.

The hydraulic cement imported into the United States in 1923 exceeded the imports for every other year since 1907 and showed an increase of more than 400 per cent over the imports of 1922. The average of the values assigned to the imports, which are supposed to represent the market values in the foreign countries from which the material is exported, was $1.77 a barrel in 1923, compared with $1.94 in 1922. These reported values are not consistent if compared with the average mill prices of domestic cement, as it seems to be a well-established fact that in late years foreign cements have been competing seriously with American cement at seaports on account of the low prices at which they have been sold. As one southern manufacturer has written,[13]

> Owing to cheap labor costs, compared with labor costs here so high as to constitute about one-fourth of the total cost of manufacturing a barrel of Portland cement, to freight rates across the Atlantic so low as to amount almost to cement coming in as ballast, our southern ports are receiving large quantities of European cement which is underselling American cement.

The tariff act of 1922 placed hydraulic cements on the free list, with the proviso that if any country imposes a duty on such cement coming from the United States, an equal duty shall be imposed upon such cement coming into the United States from such country.

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[13] The importation of foreign cement coming into competition with American produced cement: Manufacturers Record, Sept. 6, 1923.

Roman, Portland, and other hydraulic cements imported into the United States in 1922 and 1923, by countries

[General imports]

Country	1922		1923	
	Barrels	Value	Barrels	Value
Belgium	10, 682	$20, 555	200, 718	$295, 518
Canada:				
Maritime Provinces	33, 505	70, 313	1, 311	2, 522
Quebec and Ontario	86, 657	193, 830	217, 018	392, 563
Prairie Provinces	185	350	453	1, 002
British Columbia and Yukon	6, 869	22, 860	9, 812	32, 739
Denmark	118, 499	199, 484	370, 410	573, 701
Dominican Republic	53	170		
England	12	38	186, 152	430, 470
France	1, 668	3, 324	1, 703	2, 775
Germany	6	10	47, 344	75, 966
Italy			(a)	10
Japan	3, 890	12, 100	48	165
Mexico	1, 001	2, 768	(a)	2
Netherlands	149	375	1, 996	3, 432
Norway	125	233	420, 233	752, 047
Philippine Islands			(a)	3
Poland and Danzig	6	13		
Sweden	60, 492	102, 330	211, 555	386, 606
Turkey in Europe	24	93	95	255
Virgin Islands of the United States			9, 788	14, 322
	323, 823	628, 846	1, 678, 636	2, 964, 098

[a] Not recorded.

Roman, Portland, and other hydraulic cements imported into the United States in 1922 and 1923, by districts

[General imports]

District	1922		1923	
	Barrels	Value	Barrels	Value
Buffalo	310	$577	66, 790	$117, 984
Chicago	6	36		
Connecticut			(a)	7
Dakota	185	350	453	1, 002
Duluth-Superior	399	1, 269		
Florida	20, 017	38, 023	103, 759	199, 702
Galveston			3, 754	5, 659
Georgia			18, 575	27, 905
Hawaii	3, 891	12, 100	72, 323	136, 256
Los Angeles			408, 198	715, 649
Maine and New Hampshire	614	1, 575	3, 205	7, 236
Maryland			2, 502	3, 560
Massachusetts			6, 202	9, 629
Michigan	5, 647	34, 035	155	540
Minnesota			(a)	4
New Orleans	12	25	92, 670	154, 416
New York	810	1, 937	63, 359	101, 296
North Carolina	107, 794	177, 070	168, 595	381, 788
Oregon	203	403	111, 511	185, 489
Philadelphia	6	3		
Porto Rico	105, 512	207, 495	248, 729	374, 234
Rochester	11, 992	20, 005	5, 618	10, 507
San Antonio	102	368		
San Diego	906	2, 400		
San Francisco	11, 694	22, 456	102, 786	161, 883
South Carolina			36, 185	53, 302
St. Lawrence	9, 817	17, 549	44, 329	82, 238
Vermont	37, 037	68, 310	91, 763	167, 297
Virginia			5, 615	9, 442
Washington	6, 869	22, 860	21, 560	57, 073
	323, 823	628, 846	1, 678, 636	2, 964, 098

[a] Not recorded.

Hydraulic cement imported for consumption in the United States, 1916–1923

Year	Barrels [a]	Year	Barrels [a]
1916	1,836	1920	524,604
1917	2,323	1921	122,317
1918	305	1922	355,931
1919	8,931	1923	1,767,264

[a] Barrels of 376 pounds in 1920–1923, and 380 pounds in earlier years.

The desirability of presenting in this chapter a table showing production of cement in the principal countries has long been borne in mind, but the inadequacy of reliable data has prevented the fulfillment of this desire. As it is, few foreign countries collect or publish data on cement production. Such important countries, for instance, as Great Britain, Germany, Russia, Austria, Hungary, and Czechoslovakia issue no official data on the subject, except possibly in census years, and any compilation that could be made from official statistics would be too far from complete. Unofficial estimates of annual capacity and of production are available for many countries for which no more trustworthy data can be found, but as such estimates are probably mostly clever guesses, not based on extensive investigations, it is deemed inadvisable to give them official recognition.

A series of three pamphlets on international trade in cement were issued early in 1924 by the Bureau of Foreign and Domestic Commerce, Department of Commerce, as supplements to Commerce Reports. The first covers North and South America, the second Europe, and the third Asia, Australia, and Africa. These reports discuss conditions in the cement industry in the different countries, describe local cement plants, make some estimates of local production, compare prices, and give many data on imports and exports of the countries, with sources of supply. Most of the statistical data cover a pre-war period, such as 1911 to 1913, and a post-war period, such as 1919 to 1922. For few countries are figures for 1923 available, and for many of them none later than 1920. The sources of information are official statistics of exports and imports, trade publications, and reports of consular officers of the Department of State and foreign representatives of the Department of Commerce. Although the data lack uniformity and many of them are not up to date, and although they include many estimates, they undoubtedly present the best information available on the subject and should constitute a valuable guide to the few American cement manufacturers who are interested in the possible export markets for domestic cement, and, what is of more importance to the American cement industry, they may be of help in studying the subject of cement imports.

CEMENT PRODUCTION IN CANADA

Ten plants were reported as producing cement in Canada during 1923—4 in Ontario, 1 in Quebec, 2 in Manitoba, 2 in Alberta, and 1 in British Columbia.

The total mill output of Portland cement was 7,688,196 barrels, with an estimated value of $15,417,587. The production (sales) amounted to 7,543,590 barrels, valued at $15,064,661; the records for 1922 showed 6,943,972 barrels, valued at $15,438,481. Thus there was an increase in quantity of 599,618 barrels but a decrease in value of $373,820. The average selling price over the whole Dominion for 1923, computed from the total quantity sold and the total receipts recorded, was $2 a barrel, as compared with $2.22 a barrel in 1922.

Summary statistics of the cement industry in Canada, 1922 and 1923 [a]

	1922		1923	
	Barrels	Value	Barrels	Value
Output	6,447,696	$14,324,715	7,688,196	$15,417,587
Sold or used	6,943,972	15,438,481	7,543,590	15,064,661
Stocks Dec. 31	1,106,939		1,251,545	
Imports:				
Portland cement	30,914	96,310	17,697	75,294
Manufactures		13,273		86,974
Exports	425,137	699,738	493,751	824,811
Consumption	6,549,749		7,067,536	

[a] Dominion Bur. Statistics Prel. Rept., 1923.

GOVERNMENT AND STATE PUBLICATIONS ON CEMENT MATERIALS, CEMENT, AND CONCRETE

UNITED STATES GEOLOGICAL SURVEY

The following list includes the principal publications on cement and concrete materials by the United States Geological Survey. The priced publications, except as noted, may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. The Survey does not distribute any other than its own publications. The reports that are no longer purchasable may be consulted in libraries of cities and educational institutions.

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——— Portland cement: Bull. 666–S, pp. 113–117, 1917. Edition exhausted.

——— Cement: Mineral Resources for 1909, pt. 2, pp. 433–452, 1911, 75c; for 1910, pt. 2, pp. 469–535, 1911, $1.25; for 1911, pt. 2, pp. 485–519, 1912, $1.10; for 1912, pt. 2, pp. 503–524, 1913, $1; for 1913, pt. 2, pp. 117–143, 1914, $1.25; for 1914, pt. 2, pp. 221–259, 1916, 80c.; for 1915, pt. 2, pp. 189–212, 1917, 75c; for 1916, pt. 2, pp. 341–375, 1918, $1; for 1917, pt. 2, pp. 343–380, 1919, $1.50; for 1918, pt. 2, pp. 565–627, 1920, $1; for 1919, pt. 2, pp. 387–404, 1921, 5c; for 1920, pt. 2, pp. 263–282, 1922, 5c.

Burchard, E. F., and Bagley, B. W., Cement: Mineral Resources for 1921, pt. 2, pp. 215–228, 1923, 5c; for 1922, pt. 2, pp. 227–249, 1923, 5c.

——— (See also Eckel, E. C.)

Catlett, C., Cement resources of the Valley of Virginia: Bull. 225, pp. 457–461, 1904. Edition exhausted.

Clapp, F. G., Limestones of southwestern Pennsylvania: Bull 249, 52 pp., 1905. 20c.

Crider, A. F., Cement resources of northeast Mississippi: Bull. 260, pp. 510–521, 1905. 40c.

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From time to time investigative work is done by certain of the State geological surveys, and many detailed reports have been published on important local deposits. The surveys of the following States have made special studies of local cement resources: Alabama, Arkansas, California, Georgia, Illinois, Indiana, Iowa, Maryland, Michigan, Mississippi, Missouri, New Jersey, New York, North Dakota, Ohio, Oklahoma, South Dakota, Vermont, Virginia, Washington, and West Virginia. Certain other States have done a little work on their cement materials.

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ABRASIVE MATERIALS

By Frank J. Katz[1]

INTRODUCTION

The production of natural abrasive materials is a varied industry in which a considerable number of widely scattered dissimilar enterprises are engaged in placing different commodities on the markets. By present-day standards in mining and manufacturing few, if any, of these enterprises would be considered large. Nevertheless, individually as well as collectively, they are important elements in the industrial life of the country, inasmuch as they supply tools for grinding, polishing, and other abrasive operations and the ingredients of cleansing compounds, without which the great wood, leather, and metal working and other industries and many householders would be put to great expense and inconvenience in the use of substitutes.

This chapter considers mineral products which as such or as essential constituents of manufactured products are used as abrasive materials. Some of these mineral products are used in other ways also—for example, tripoli as a filler and diatomaceous earth for thermal insulation. With these minerals segregation of production according to uses is difficult, but the total production for all uses is shown in this report. Feldspar and quartz, both of which are used as abrasives, are excluded from this report because that is not their principal use and because precise separation of the statistics according to uses is impossible. Therefore they are considered in other chapters of Mineral Resources, entitled "Feldspar" and "Silica."

Statistics on artificial abrasives are included for comparison and because of their strong influence on the marketing of natural abrasives.

During 1923 the abrasive industry enjoyed, in common with the other mineral industries generally, general prosperity, as compared with the two years preceding. All varieties of abrasives covered in this report shared in the increase in production. The production of garnet, emery, and artificial abrasives probably marks more clearly than that of most other materials the general return to activity in industry. Aside from this showing of healthier tone in the business, there were no changes that merit especial note.

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[1] Statistics of production were compiled by Miss A. T. Coons, of the Geological Survey. Data on imports and exports were compiled by J. A. Dorsey, of the Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce.

NATURAL ABRASIVES

Under the head of natural abrasives in this report are included millstones and related quarry products, such as chasers, dragstones, and paving stone for chaser mills; grindstones and pulpstones; oilstones, whetstones, hones, scythestones, and rubbing stones; corundum and emery; abrasive garnet; tripoli; diatomaceous earth; pumice; and pebbles and lining for tube mills. These natural abrasives were produced in 1923 in 27 States, as follows:

Arizona	Pumice.
Arkansas	Oilstones.
California	Diatomaceous earth, grinding pebbles, and pumice.
Idaho	Pumice.
Illinois	Tripoli.
Indiana	Oilstones, rubbing stones, and scythestones.
Kansas	Pumice.
Kentucky	Hones.
Maine	Millstones.
Maryland	Diatomaceous earth.
Michigan	Grindstones.
Minnesota	Grinding pebbles, millstones, and tube-mill lining.
Missouri	Tripoli.
Nebraska	Pumice.
Nevada	Diatomaceous earth.
New Hampshire	Diatomaceous earth, garnet, and scythestones.
New York	Diatomaceous earth, emery, garnet, and millstones.
North Carolina	Garnet and millstones.
Ohio	Grindstones, pulpstones, oilstones, rubbing stones, and scythestones.
Oklahoma	Tripoli.
Oregon	Diatomaceous earth.
Pennsylvania	Rottenstone.
Utah	Pumice.
Vermont	Scythestones.
Virginia	Emery and millstones.
Washington	Diatomaceous earth and pulpstones
West Virginia	Grindstones and pulpstones.

MILLSTONES

American millstones have been and are still for the most part made of quartz sandstone and conglomerate, chiefly in Ulster County, N. Y., and Montgomery County, Va., but also in Pennsylvania. Millstones are also made of granite, particularly in Alabama, Maine, Minnesota, New Hampshire, and North Carolina. The production recorded in Mineral Resources includes only the stones made for other than purely local use. Doubtless a large number of stones have been made in many unrecorded localities as local use has required, and they have been made of other rocks than those specified, particularly in the mountain sections of the Southern States. Formerly the millstone manufacturing industry was much larger than at present. About 1880 the total value of the stones produced and sold in the United States was around $200,000 annually. The production has declined since the late eighties and during the last three years has been from $20,000 to $25,000 worth of stones annually. The decline is due in part to the fact that the manufacture of millstones is a hand craft in which, as in many others in the United States, the old master craftsmen who are gradually disappearing are not being replaced. In part also the change is due to new processes in the grain, paint, and mineral milling industries in which the old-style burrstones and chaser mills are being supplanted by grinding equipment of an entirely different type.

The value of the millstones (burrstones) and related quarry products—chasers, dragstones, and pavers—sold by producers in the United States in 1923 was a little more than in 1922, but less than in 1921 and other recent years.

In 1919 to 1922 as the output and number of producers decreased in other States they increased in New York.

Value of millstones, chasers, and dragstones sold by producers, 1919–1923

State	1919		1920		1921		1922		1923	
	Number of producers	Value	Number of producers	Value	Number of producers	Value	Number of producers	Value	Number of producers	Value
New York	7	$10,155	8	$13,331	12	$14,672	12	$17,025	17	$14,344
Other States [a]	11	56,817	11	49,994	7	9,852	4	3,828	4	7,885
	18	66,972	19	63,325	19	24,524	16	20,853	21	22,229

[a] 1919: Alabama, North Carolina, Pennsylvania, and Virginia. 1920: Alabama, Maryland, North Carolina, and Virginia. 1921: Alabama, New Hampshire, North Carolina, and Virginia. 1922: Alabama, North Carolina, and Virginia. 1923: Maine, Minnesota, North Carolina, and Virginia.

GRINDSTONES AND PULPSTONES

Grindstones and pulpstones are made from sandstone in northeastern and eastern Ohio, western West Virginia, eastern Michigan, and during the last few years in Pierce County, Wash. In 1923 there was a notable increase in the total quantity of grindstones and pulpstones, as compared with 1922 and 1921, though not as compared with 1919 and 1920. The total value of such stones sold by producers in 1923 was $1,689,315.

Grindstones and pulpstones sold by producers, 1919–1923 [a]

Year	Grindstones		Pulpstones	
	Short tons	Value	Pieces	Value
1919	40,755	$993,959	2,450	$342,056
1920	44,832	1,239,990	2,321	467,014
1921	16,310	477,259	2,941	750,063
1922	21,367	574,900	[a] 1,619	[a] 445,286
1923	37,384	1,008,899	2,533	680,416

[a] Exclusive of sales in Washington prior to 1923.

OILSTONES AND SCYTHESTONES

Oilstones were produced from novaculite quarried in Arkansas, whetstones and scythestones from sandstone quarried in Ohio and Indiana, scythestones from schist quarried in Vermont and New Hampshire, and rubbing stones from sandstone quarried in Indiana and Ohio. Sales of natural hones were reported by only one firm in Kentucky. Most of the output of this group as reported to the Geological Survey consisted of oilstones from Arkansas; next in rank were scythestones from New Hampshire, Vermont, and Ohio.

The output of oilstones, whetstones, hones, scythestones, and rubbing stones for the last five years has been as follows: 1919, 1,463 short tons, valued at $235,943; 1920, 1,144 tons, $231,747; 1921, 831 tons, $173,025; 1922, 1,016 tons, $197,450; 1923, 1,223 tons, $231,812.

CORUNDUM AND EMERY

The domestic sources of emery are in the Peekskill region, N. Y., and Pittsylvania County, Va. The good emery in the deposits formerly worked in the vicinity of Chester, Hampden County, Mass., appears to be exhausted.

Corundum resources were formerly exploited in a large number of localities in the Appalachian section of North Carolina and Georgia. There has been no regular production of corundum in the United States since 1906, although small lots were mined and sold during the World War. In 1923 the production of emery recovered from the severe slump of 1921 and 1922 and nearly reached the quantity recorded in 1919 and 1920.

Although domestic emery does not enjoy the reputation for high quality accorded to Grecian and Turkish emery, it nevertheless appears to be very satisfactory for certain grinding and polishing operations.

A valuable article on the marketing of emery and corundum, by H. A. Plusch, was published in the Engineering and Mining Journal-Press, August 30, 1924, pages 339–340.

The emery sold or used by producers, in the last five years, has been as follows: 1919, 2,601 short tons, valued at $23,203; 1920, 2,327 tons, $21,685; 1921, 305 tons, $2,250; 1922, 1,468 tons, $17,511; 1923, 2,286 tons, $29,478.

GARNET

Abrasive garnet is produced in Warren and Essex counties, N. Y.; Merrimack County, N. H.; and Clay and Jackson counties, N. C. In former years a little was produced in Pennsylvania and Connecticut. The principal producing region is Warren County, N. Y. In 1923 the output of abrasive garnet rose to an unprecedented figure, and the average value at the mines was approximately $76 a ton. The figures indicate an unusual growth in the use of garnet as an abrasive material and the recognition of the peculiar worth of garnet in certain finishing processes, especially wood and leather finishing and in shoe manufacturing. In these processes garnet is used chiefly on paper or cloth in the form of ordinary sandpaper and on belts and specially shaped forms.

Recent articles describing garnet resources, methods of mining and preparation, uses, and marketing will be found in the Canadian Mining Journal, July 18, 1924, pages 685–686, and in the Engineering and Mining Journal-Press, October 4, 1924, pages 525–532.

The garnet sold or used by producers in the last five years has been as follows: 1919, 4,944 short tons, valued at $310,131; 1920, 5,476 tons, $434,425; 1921, 3,048 tons, $260,687; 1922, 7,054 tons, $566,879; 1923, 9,006 tons, $688,437

TRIPOLI

The material called tripoli in the trade in the United States is a white, yellowish, or pinkish, light, porous, absorbent, and generally pure siliceous rock that has resulted from the leaching of calcareous material from highly siliceous limestone or highly calcareous chert, or from the leaching of fine-grained siliceous shale by a process that leaves only silica, or from the chemical weathering and disintegration of novaculite. In its origin and properties and in some of its uses tripoli is like "rottenstone," a small output of which is here reported with tripoli. The "rottenstone" produced in Pennsylvania and also "rottenstones" from England and Scotland appear on examination to be essentially very fine-grained argillaceous material and therefore quite different from tripoli in composition.

The principal commercial sources of tripoli are southwestern Missouri, southeastern Oklahoma, and southern Illinois. The occurrence of tripoli is also known at several localities in the Appalachian region of the Southern States, especially in Tennessee and in Georgia, where there has been some production. Tripoli is also abundant in the Ozark Mountain region of Arkansas.

Some of the Missouri-Oklahoma tripoli is produced primarily for use as an abrasive, but most of it is mined to be worked up into filter blocks, the cuttings and waste from the making of which are ground and prepared for abrasive and other uses. A large part of the Missouri output is also used as filler, for foundry facings, and in many other ways. The Illinois product is generally known simply as "silica," and though used to some extent as an abrasive for metal polishes, in soaps, and in cleansers, it is very largely used in paint and fillers, in making glass, in the body and enamel of ceramic wares, and for facing foundry molds.

The properties, occurrence, history, preparation, and uses of tripoli are described in an article by P. B. Butler and G. V. B. Levings in the Metal Industry, January, 1924, pages 10–14.

It is not possible to determine the amounts of tripoli used as abrasive material and otherwise, nor to obtain from the producers uniform reports on the quantity and value of the crude or rough quarried material, as they sell much of the product originally in some manufactured or prepared form. Statistics herein reported and in earlier chapters of Mineral Resources therefore do not permit satisfactory comparison between years or between producing States.

In the following table the value assigned for crude material is estimated by the Geological Survey; the other figures are reported by the producers.

Tripoli produced and sold, 1922–23

State	1922			1923		
	Short tons	Value		Short tons	Value	
		Crude (estimated)	As sold (crude and finished)		Crude (estimated)	As sold (crude and finished)
Illinois	18,747	$54,741	$194,371	11,522	$31,230	$117,201
Missouri, Oklahoma, and Pennsylvania [a]	11,458	50,568	122,357	15,560	30,960	265,556
	30,205	105,309	316,728	27,082	62,190	382,757

[a] The Pennsylvania product is sold as "rottenstone."

The output and the value as sold (crude and finished) for 1919-1921 were as follows: 1919, 24,292 short tons, $181,541; 1920, 40,233 tons, $569,677; 1921, 12,340 tons, $213,013.

DIATOMACEOUS EARTH

Diatomaceous earth, also called infusorial earth and sold under various trade names, is a light earthy material which as obtained from some sources is loose and powdery, and from others is more or less firmly coherent. Much of it resembles chalk or clay, but it can be distinguished at once from chalk by the fact that it does not effervesce when treated with acids. It is generally white or gray but may be yellowish, pinkish, or brown, owing to the presence of impurities, or even black when mixed with much organic matter. Diatomaceous earth is made up of the remains of minute aquatic plants and is composed chemically of hydrous silica.

Deposits of diatomaceous earth are widespread in many parts of the Western States, particularly California, Idaho, Oregon, Washington, and Nevada, where in some places it occurs in very thick beds which are remarkably uniform and pure. Diatomaceous earth is also widespread in beds underlying the coastal region of Maryland and Virginia, occupying the triangular area roughly marked by Annapolis on the northeast, Richmond on the southwest, and the Dismal Swamp region on the southeast. In this region, however, the beds vary in quality or degree of purity and in thickness and are not known to be continuous, though some excellent diatomaceous material has been found within the region. In the northern part of the United States, especially that part geologically known as the glaciated region, and also in the lake region of Florida, diatomaceous deposits on lake bottoms or beneath accumulations of muck in swamps are also abundant.

At present the production of diatomaceous earth in the United States is practically limited to the thick beds of pure earth in California, Oregon, Washington, and Nevada. A little is produced in New York and Maryland and at irregular intervals in several other States.

The diatomaceous earth sold or used by producers in the last five years has been as follows: 1919, 42,642 short tons, valued at $531,960; 1920, 61,922 tons, $1,079,693; 1921 (partly estimated), 55,134 tons, $682,616; 1922, 44,761 tons, $386,669; 1923, 65,833 tons, $699,406.

PUMICE

The domestic product sold as pumice is almost wholly a finely fragmental volcanic glass or so-called volcanic dust or "ash." This material is dug from deposits in which it is interbedded with other sedimentary materials or from deposits of "ash" that blanket the surface. The principal sources of production are in Kansas and Nebraska, but small quantites have been produced in California and other Western States. The domestic production in recent years has included also some lump pumice produced in Arizona and California. This lump pumice is fairly comparable with the imported Italian pumice, which formerly constituted the bulk of the pumice used in this country. Much of the Italian pumice was crushed and ground for use in the form of powder, and in that state it was not appreciably different from the domestic volcanic dust or "ash," which is a satisfactory substitute for it.

The pumice sold or used by producers in the last five years has been as follows: 1919, 36,051 short tons, valued at $116,835; 1920, 41,838 tons, $114,433; 1921, 37,108 tons, $158,540; 1922, 45,262 tons, $175,600; 1923, 56,575 tons, $214,169.

PEBBLES FOR GRINDING

The production of pebbles used for grinding minerals, ores, and cement ingredients and clinker, and for other purposes, together with the output of quartzite blocks for use as tube-mill liners, reported below, includes only the output of beach pebbles in southern California and of cut cubes or pebbles and liners made of quartzite in Minnesota. The figures appear to cover the entire commercial output, but there was doubtless an unrecorded additional production for local use by the producing concerns.

The production in 1923 showed a considerable increase over that of 1922 and was more than four times that of 1921. It was nevertheless far below the output during the years 1917–1920, when efforts of domestic producers were stimulated by a threatened shortage of the supply of imported pebbles during the period of the war.

The figures for the last five years are as follows: 1919, 9,448 short tons, valued at $85,302; 1920, 10,924 tons, $77,823; 1921, 989 tons, $14,637; 1922 3,159 tons, $30,798; 1923, 4,551 tons, $51,795.

IMPORTS AND EXPORTS

Value of abrasive materials imported for consumption, 1920–1923

Material	1920	1921	1922	1923
Millstones and burrstones	$20, 954	$13, 556	$15, 356	$20, 102
Grindstones and pulpstones	77, 046	81, 880	81, 733	106, 028
Hones, oilstones, and whetstones	56, 416	35, 761	48, 938	53, 233
Emery and corundum	617, 187	393, 454	389, 390	722, 688
Diatomaceous earth, tripoli, and rottenstone	16, 323	13, 203	10, 429	11, 779
Pumice	249, 995	173, 201	118, 458	128, 693
Diamond dust and bort	3, 387, 488	466, 345	1, 029, 261	228, 409
Flint, flints, and flintstones, unground	338, 630	116, 157	145, 805	130, 974
Garnet	([a])	([a])	[a] 1, 837	93, 803

[a] Not separately classified prior to new tariff, Sept. 22, 1922.

The figures for millstones and burrstones may be divided as follows: Rough, 1920, $9,007; 1921, $3,075; 1922, $7,412; 1923, $17.214; made into millstones, 1920, $11,947; 1921, $10,481; 1922, $7,944; 1923, $2,888.

Emery and corundum imported for consumption, 1921–1923

Year	Grains		Ore and rock		Other manufactures
	Pounds	Value	Long tons	Value	
1921	1, 504, 971	$82, 771	6, 169	$281, 931	$28, 752
1922	381, 222	16, 643	5, 297	329, 902	42, 845
1923	427, 567	18, 721	11, 362	610, 518	93, 449

General imports of pebbles and flint, 1920–1923

Country	1920		1921		1922		1923	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Belgium	4, 269	$65, 097	1, 365	$23, 404	902	$15, 460	2, 012	$22, 152
Canada	96	430	280	1, 510	193	920	766	3, 409
Czechoslovakia							32	484
Denmark	10, 618	131, 028	3, 249	36, 924	4, 807	51, 076	3, 908	43, 886
England					(a)	8	34	365
France	11, 469	131, 950	5, 188	54, 248	9, 723	73, 636	8, 955	57, 401
Germany	157	9, 528	2	53	251	2, 932	226	2, 572
Japan							(a)	5
Mexico	2	30						
Netherlands	25	567			58	681		
Norway					50	421	19	700
Poland and Danzig					56	671		
Scotland			(a)	18				
	26, 636	338, 630	10, 084	116, 157	16, 040	145, 805	15, 952	130, 974

[a] Less than 1 ton.

Value of domestic abrasive materials exported, 1920–1923

Material	1920	1921	1922	1923
Grindstones	$424, 322	$281, 976	$281, 413	$499, 123
Abrasive wheels, emery, and other	2, 791, 128	1, 318, 804	644, 151	571, 733
All other natural abrasives, hones, whetstones, etc	3, 810, 171	1, 719, 810	292, 051	342, 737
	7, 025, 621	3, 320, 590	1, 217, 615	1, 413, 593

ARTIFICIAL ABRASIVES

The artificial abrasives here considered are of three kinds—(1) metallic abrasives, (2) silicon carbide, and (3) aluminum oxide. These products are manufactured by the following concerns, some of which make more than one kind, as indicated by the numbers in parentheses:

Pittsburgh Crushed Steel Co., Pittsburgh, Pa. (1).
Globe Steel Abrasive Co., Mansfield, Ohio (1).
Carborundum Co., Niagara Falls, N. Y. (2, 3); Niagara Falls, Ontario (3); and Shawinigan Falls, Quebec (3).
Canadian Carborundum Co. (Ltd.), Shawinigan Falls, Quebec (2, 3).
Norton Co., Niagara Falls, N. Y., and Chippewa, Ontario (2, 3).
General Abrasive Co. (Inc.), Niagara Falls, N. Y. (3).
Exolon Co., Thorold, Ontario, and Blasdell, N. Y., (2, 3).
Abrasive Co. of Canada, Hamilton, Ontario (3).
National Abrasive Co., Hamilton, Ontario (3).

The figures given in the following table represent the crude or immediate product of the electric furnaces in which the carbide and aluminum oxide abrasives are manufactured. Much of the product there reported is subject to further manufacture before being sold. Although an undeterminable quantity is not used finally as abrasive material, the total output is here included because it is thought that the portion used as abrasive material has not fluctuated so widely as to destroy the value of these figures for comparison with the statistics of production of natural abrasives.

Crude artificial abrasives, sold, shipped, or used, from manufacturing plants in the United States and Canada, 1919–1923

Year	Silicon carbide		Aluminum oxide		Metallic abrasives		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1919	28, 435	$3, 380, 151	19, 723	$3, 811, 498	2, 360	$274, 200	50, 518	$7, 465, 849
1920	6, 887	1, 309, 605	32, 891	5, 956. 639	2, 659	225, 920	42, 437	7, 492, 164
1921	2, 707	475, 336	7, 325	1, 318, 771	3, 167	202, 040	13, 199	1, 996, 147
1922	16, 233	2, 022, 613	31, 898	3, 246, 714	5, 804	421, 148	53, 935	5, 690, 475
1923	21, 149	2. 786, 929	51, 391	5, 378, 926	8, 229	612, 140	80, 769	8, 777, 995

WORLD'S PRODUCTION

The following table was compiled by Miss W. I. Whiteside, of the United States Geological Survey, from official data so far as available and the most reliable other sources.

World's production of natural abrasives, 1913–1923, in metric tons

	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Corundum:											
Australia, Western (exports)	(a)	(a)	(a)	(a)	(a)	(a)	1	(a)	(b)	(a)	(a)
Canada	1,068	497	238	61	171	124		178	366		
India, British	404	120	63	1,898	2,105	2,046	718	213	65		
Madagascar	1,099	556	327	914	734	178	812	521	285	186	421
Russia	(a)	(a)	(a)	(a)	(a)	(a)	(a)	63	7	2	(a)
Union of South Africa	12	11	62	685	2,385	3,515	162	236	112	1,836	2,554
United States					744	(c)					
Diatomaceous earth:											
Algeria	(a)	(a)	(a)	(a)	(a)	(a)	1,000	1,500	800	2,480	10,000
Australia—											
New South Wales	25	25	40	239	142	20	89	390	209	489	523
Victoria	152	1,016	278		762	142	159	1,016			
Chosen	(a)	(a)	(a)	(a)	(a)	(a)	30,054	28,820	24,313	38,904	
France	1,725	(a)	(a)	(a)	(a)	(a)	2,500	3,800	4,580	(a)	(a)
Italy	20	20	20				15	25	875	175	420
Sweden	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	600	322	(a)
United Kingdom	156										
United States	5,975	9,990	[d] 4,167	[d] 2,468	[d] 2,751	[d] 2,690	38,684	56,174	50,016	40,606	59,722
Emery:											
Germany (Bavaria)	(a)	260	80	90	50	50	170	140	243	420	400
Greece	5,560	16,112	14,338	19,871	16,440	[e] 12,600	9,300	11,089	12,709	13,000	21,626
Russia	(a)	(a)	(a)	(a)	(a)	(a)	676	511	(a)	(a)	(a)
Turkey	42,437	19,110	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
United States	868	440	2,779	13,864	14,801	[e] 9,455	2,360	2,111	277	1,332	2,074
Garnet:											
Madagascar										10	5
Spain	(a)	(a)	(a)	(a)	(a)	(a)	801	198	5	(a)	982
United States	4,815	3,838	3,902	5,398	4,531	4,260	4,485	4,968	2,765	6,399	8,170
Grinding pebbles and tube-mill lining:											
Denmark	(a)	(a)	(a)	(a)	(a)	(a)	(a)	11,162	13,000	15,726	20,914
France	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
United States				(f)	13,653	11,312	8,571	9,910	897	2,866	4,129
Grindstones and pulpstones:											
Canada (grindstones)	4,388	3,607	2,341	3,155	2,289	2,787	1,833	2,217	1,162	912	1,354
Italy (grindstones)	913	150	161	1,025	806	710	1,340	1,410	860	875	960
United States	(g)	[h] 43,791	[h] 38,667	[h] 46,120	[h] 49,380	59,274	42,515	48,520	23,895	24,062	42,247

Millstones:											
France	29,994	(a)	(a)	(a)	(a)	(a)	24,742	19,240	19,300	19,105	(a)
Greece (sales)	[i] 5,618	[i] 5,874	[i] 5,423	[i] 1,321	[i] 4,070	(a)	[i] 9,200	[i] 2,728	[i] 14,348	[i] 5,324	[i] 2,400
Italy	3,701	4,584	3,794	2,204	1,453	1,153	1,858	1,857	1,934	1,885	2,220
United States	(j)	(j)	(j)	(j)	(j)	(j)	(j)	(j)	(j)	(j)	(j)
Yugoslavia (exports)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	334	(a)	(a)	(k)
Oilstones, scythestones, etc.:											
Belgium (whetstones)	[i] 125,800	[i] 77,440		[i] 1,900		[i] 3,000	[i] 31,800	[i] 67,800	[i] 77,550	[i] 68,930	[i] 207,950
France (whetstones)	628	(a)	(a)	(a)	(a)	(a)	440	500	850	778	(a)
Germany (Bavaria) (whetstones)	(a)	15	5		5	12	14	15	29	43	42
United States	(l)	(l)	(l)	(l)	1,647	916	1,327	1,038	754	922	1,109
Pumice:											
Italy—											
Crude	14,973	14,376	10,242	9,287	11,312	4,473	13,210	25,200	10,968	21,036	30,473
Ground					5,705	7,900	8,450	9,325			
New Zealand	2,726	2,464	1,940	4,129	2,195	2,298	1,054	2,889	2,992	3,068	3,776
United States	22,283	25,030	25,136	30,227	32,017	27,793	32,705	37,955	33,664	41,061	51,324
Tripoli:											
Canada (tripolite)	562	590	288	562	544	454	513	236	309	199	118
France	29	(a)	(a)	(a)	(a)	(a)	34	54	(a)	(a)	(a)
Spain							110	597	494	524	869
United States	18,867	15,620	27,860	39,242	23,649	18,127	22,037	36,499	11,195	27,401	24,568

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[a] Data not available.

[b] 25 kilograms.

[c] Corundum included under "Emery."

[d] Exclusive of considerable production for special uses upon which the Survey is not at liberty to report.

[e] Exports from Syra.

[f] Grinding pebbles only, valued at $42,500. Weight not recorded.

[g] Weight not recorded. Output valued at $855,627.

[h] Grindstones only. Pulpstones not recorded by weight but by pieces, as follows: 1914, 697; 1915, 696; 1916, 1,066; 1917, 2,325.

[i] Pieces.

[j] Weight not recorded but value was as follows: 1913, $56,163; 1914, $43,316; 1915, $53,480; 1916, $44,559; 1917, $43,489; 1918, $92,514; 1919, $66,972; 1920, $63,325; 1921, $24,524; 1922, $20,853; 1923, $22,229.

[k] Recorded as 46 stones; weight not given.

[l] Weight not recorded but value was as follows: 1913, $207,352; 1914, $167,948; 1915, $115,175; 1916, $154,573.

ASBESTOS

By Edward Sampson

PRODUCTION

The domestic asbestos industry in 1923 showed slightly better conditions than in 1922, when operations were brought almost to a complete standstill. Competition between the mines of Quebec and Rhodesia remained exceedingly keen, and as a result the prices of crude fiber continued to decrease to figures so extremely low that there was no profit in mining in the Arizona field. The prices of the shorter grades of mill fiber, on which there is little competition other than among the Canadian producers themselves, remained firm or even increased, so that those mines in this country which produce fiber that competes with short Canadian fiber were in a more favorable position than in 1922. In consequence the sales of California mill fiber were resumed, and there was noteworthy activity in the mass-fiber anthophyllite field of Georgia. The total sales of all grades of asbestos in 1923 were 227 short tons, valued at $9,626. A comparison with the figures of preceding years is given in the following table:

Domestic asbestos sold in the United States, 1919–1923

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1919	502	$229,265	659	$19,000	1,161	$248,265
1920	1,245	661,907	403	16,324	1,648	678,231
1921	438	313,268	393	23,700	831	336,968
1922	25	3,320	42	6,800	67	10,120
1923	69	4,433	158	5,193	227	9,626

REVIEW BY STATES

ARIZONA

There was considerable activity in the Arizona field, although the dullness of the asbestos market prevented vigorous mining. The established mines were all closed, but on the Indian reservations and in the Cherry Creek district newly acquired properties were being developed.

On the San Carlos Reservation the most extensive work was on the Accident group of claims, which lie on the west side of Cienega Canyon, about halfway between the falls of Cienega Creek and Salt River. This property is owned by Robert M. Anderson, George England, and MacD. Robinson. It was located in 1921 and leased in August, 1922. On August 6, 1923, the property was turned over to O'Neil & Jamison, who made a first payment and planned large-scale mining and manufacturing operations, but the second payment was defaulted, and the property reverted to the original owners. The developments consist of half a mile of trail over difficult country to the rim of the canyon, an open cut 55 feet long, and about 200 feet of underground workings.

On the Penn group, owned by the Apache Asbestos Co., and on the Great View group, owned by J. B. Cobb, G. P. Bartlett, and others, both of which lie a little east of the Accident group, only assessment work has been done.

The two claims at the mouth of Sawmill Creek owned by W. M. & J. E. Malone were explored during the year. A cable crossing was built over Sawmill Creek and a trail made from the I. S. Hole. No report has been received from the owners, but it is said that the deposit has been shown to be small.

On the Fort Apache Indian Reservation, lying on the north side of Salt River, the most extensive development work was done at the Horse Shoe group, owned by the San Carlos Asbestos Mining Co. (Inc.), of Lakeside, Ariz. This property is near the top of Salt River canyon, on the Jack Knighton trail, north of the Peninsula. A large open cut was made in the precipitous bluff in which the deposit lies, and when the overburden became excessive underground work was done. Unlike the practice at most other mines in the district the drifting was so done as to block out the "ore" in rectangular fashion, a practice which is to be strongly recommended even in a district where all drilling is done by hand and where there is strong inducement to follow the course of least resistance. This company also constructed a suspension bridge over Salt River a short distance above the Peninsula. As the mines on the north side of the river are dependent on burro transportation and as the river is fordable only during moderately low water, this bridge was of much value to the district. In the winter of 1923 the bridge collapsed, owing, it is reported, to excessive tightening of the suspension wires by a packer in cold weather. At present there is only a footbridge in its place, but when the market warrants active shipments a new bridge for pack animals will probably be constructed.

At the Snake Hill property of W. G. Shanley and others, near the bottom of Salt River canyon, about 2 miles above the I. S. Hole, an open cut was made to obtain footing, and two tunnels were driven from this face. About 250 feet of underground work had been done up to the end of 1923. Besides this work a 300-foot cable crossing was put in 40 feet above the river. This crossing permits the transfer of materials and connects with a trail leading up the I. S. Hole canyon, which the owners of the mine have much improved.

The Salt Bank property of W. G. Shanley and others was also opened in 1923. This property lies about halfway up the north side of Salt River canyon, a little upstream from the Regal mine.

At the Regal mine only assessment work was done, and at the Johns-Manville mines at Chrysotile only assessment and necessary maintenance work.

An important development in this field was the reorganization of the Riga Asbestos Co., which acquired a large number of claims in the Cherry Creek district, some by purchase and some by relocation. The company has in all 72 claims lying in three main groups—the Triangle, on a high point on the north side of Walnut Creek just above its junction with Cherry Creek; the Buckhorn, between Wilson and Walnut creeks about 3 miles from Cherry Creek; and the Walnut, on the southeast side of Walnut Creek about 5 miles from Cherry Creek. In 1923 this company put in 4,600 man-shifts of work, and by the end of the year about 3,000 feet of underground work had been done.

The Snowflake group has been another recent development in the Cherry Creek district. This property is owned by C. W. Williams and John S. Whitley, of Young, and lies on Wilson Creek about 2 miles from Cherry Creek. A total of 500 feet of work has been done in five tunnels, the longest 120 feet long. In the winter of 1922–23 this property was under option to George Thayer, of the Apache Asbestos Co., who is reported to have shipped 1½ tons of crude asbestos.

In the last year several companies have had under consideration projects for the manufacture of short-fiber asbestos products, which would depend on fiber obtained from their Arizona properties. These projects seem ill-advised. The manufacture of asbestos products is a highly specialized industry, for the most part in the hands of strong, experienced companies with well-organized selling forces, and there is keen competition between the companies. Unless the sources of supply were close to a railroad the cost of getting the raw material to the manufacturing plant would be excessive, and it is doubtful if any asbestos deposit in Arizona would warrant the erection of an expensive manufacturing plant that would be dependent on a supply of short fiber. The Arizona deposits consist essentially of high-grade material, and their value depends almost entirely on the amount of spinning fiber they contain. If, after mining for crude, a market can be found for the short fiber mined incidentally, that by-product may possibly bear the cost of treatment and transportation and yield a profit, if none of the cost of mining is charged against it. For a remote deposit the value of the short fiber should not enter to any appreciable extent into the estimated value of the property.

There is one deposit in the Arizona field where the prospect of operating successfully for short fiber alone is unusually favorable. This is the deposit covered by the Apache group of claims, owned by Shanley & Morrison. The claims are only 3½ miles north of Ripley siding on the Arizona Eastern Railroad, 13 miles east of Globe. Work done here in 1923 consisted of determining the extent of the deposit by open cuts and short tunnels. The fiber is very harsh but has been found to be well adapted for use in stucco. Asbestos sand and short fiber will form the most valuable part of the output, as the crude is too harsh for spinning. This property was examined in May, 1924, when a moderate amount of fiber had been developed, and in the summer of 1924 a mill was constructed to crush and screen the product.

CALIFORNIA

The Sierra Asbestos Co., whose property is near Washington, in Nevada County, Calif., and which has been the main producer in the State, did not operate in 1923 but made sales from stock mined in 1921. The California Asbestos Mining Co., which in 1920 started development of its property on Clear Creek, 26 miles from Coalinga, in San Benito County, made its first production in 1923, although it sold no fiber. The company reports that most of its work was in development of the ground and in perfecting the process of extraction of the fiber. The Pacific Asbestos Corporation, whose property is near Copperopolis, in Calaveras County, continued surface improvements such as road grading and preparation for maintenance of workmen but has not yet started mining operations. Harris & Barrett report active prospecting on their property near Jolon, in Monterey County, 100 feet of work being done in two tunnels, and a new body of promising ground was found on the surface. In Sierra County the Drifted Snow Asbestos Co. resumed active prospecting on its property near Goodyears Bar, and in Siskiyou County Amull Dennis is prospecting a deposit near Edgewood.

GEORGIA

One of the important features of the year in the asbestos industry was the keen interest shown in the mass-fiber anthophyllite deposits of Georgia. These deposits have two assets which if they can be fully utilized should prove valuable. The mineral is physically and chemically far more stable than chrysotile. It will stand a higher temperature without a breakdown of the fiber, and it is but little attacked by acids and alkalies, which exert a considerable effect on chrysotile. Besides the desirable qualities which are inherent in the mineral, it occurs in the form of mass fiber—that is, it makes up a large part of the body of the rock in which it is found. Under favorable conditions the rock is simply quarried and ground without any concentration of valuable mineral. However, in the past this process of treatment has limited exploitation to particularly pure bodies of rock, and usually the rock quarried has been only that which has been softened by weathering. During 1923 the Asbestos Mining & Manufacturing Co. conducted experiments on the separation of the anthophyllite from the gritty minerals with which it is in places associated. The process of treatment is based on well-established principles, but its application to asbestos is entirely new.

The Asbestos Mining & Milling Co. acquired title in March to the property of the American Mineral Grinding Co., near Hollywood, in Habersham County. The property is reached by the Tallulah Falls branch of the Southern Railway and is 14 miles from Cornelia and 75 miles from Atlanta. During 1923 the company further developed the deposit, which is stated to be 90 feet wide. A three-drill compressor furnishes power to the quarry. A drying shed was built in 1923, and milling machinery was installed. The general plan of the mill is as follows: Gates gyratory crusher crushing to 2 inches, bucket elevator to 15-ton bin, Jay-Bee pulverizer (hammer type) with heavy-duty suction fan, settling chamber to eliminate grit, collector, sacker. The company previously operating the deposit used a Raymond mill, but the present company has substituted a hammer-type pulverizer, which is reported to give far more satisfactory results. The plant as above described was put into operation in 1924. The experimental work of the company on a further refinement in the process of treatment bids fair to yield valuable results.

L. M. Arnold made a preliminary shipment of 93 tons of crude asbestos rock to a manufacturer of chemical filters. This sale is significant in showing a recognition of the desirable chemical qualities of anthophyllite.

It is reported that the Clayton Paving Co., of Nashville, Tenn., acquired the mine and mill of the Sall Mountain Co., near Nacoochee, and ground and shipped two carloads of asbestos, but it closed down immediately thereafter and has not resumed operations.

IDAHO

Operations in the Kamiah anthophyllite field of Idaho have been resumed. A new company, the Panhandle Asbestos Co., acquired the property formerly held by the Kamiah Asbestos Manufacturing Co. in October, 1923. The property is owned by the State of Idaho, and the present company has a 10-year lease. The principal work during the year was the perfection of a process of treatment. The company expects to market the product in the form of manufactured asphalt roofing, the mass-fiber rock being ground in a ball mill. It is reported also that a rock made up of a very harsh, brittle fiber may be ground to yield a product of value to the paint trade. The company is expecting to use a 100-mesh product for this purpose.

The proposed use of fine asbestos powder in paint is one of considerable promise. Talc has long been used as a paint filler, and it has been found that the fibrous talc of New York is especially well suited for that use. Most of the talc so used is air floated and of about 300-mesh fineness. Asbestos of the same fineness would appear to be equally desirable, the fibrous structure giving a large surface relative to the bulk of the particle and the substance having chemical stability equal to that of talc. It is possible that finely ground anthophyllite asbestos might also find a use in the paper industry, where fibrous talc is used in large quantity. Asbestos would have to compete with talc that costs about $15 to $17 a ton at the mines in the northern part of New York.

MARYLAND

The Powhatan Mining Corporation, of Baltimore, Md., has continued the production of high-grade amphibole asbestos, which is used for chemical filters. Two types of material are now produced—"technical," a long and carefully prepared fiber used in chemical laboratories and worth about $1.20 a pound, and "commercial," a shorter fiber used by the chemical industry and worth about $120 a ton. The company has been operating again the Neikerk mine, near Pylesville.

MONTANA

The Idaho-Montana Asbestos Co. has continued the development of its property just inside the Montana State line and 36 miles from West Yellowstone, Idaho. The company is now installing a mill for the separation of short fiber. The mill is to have a capacity of 60 tons to a 10-hour shift, which is equal to that of the larger Canadian mills. The development of this property is of considerable interest, because the deposit is of the limestone type. So far as known to the writer no deposit of this type has yet yielded paying quantities of mill fiber.

VERMONT

The Asbestos Corporation of America, which has invested a large amount of capital on its property near Hyde Park, Vt., has suspended operations after operating its mill for an experimental run. The company has failed to give a report of operations, but it is understood that a reorganization will be made.

PRICES

No subject is of greater importance to asbestos miners in the United States than the prices of the several grades of asbestos, which not merely affect the amount of profit in operations but determine whether deposits of certain grades can be mined. "Crude" chrysotile could not be mined at a profit at the prices prevailing in 1923, whereas the conditions for the production of shorter grades of milled fiber" were more favorable than in 1922, and correspondingly there was a good opportunity for marketing grades of domestic amphibole asbestos which compete with the shortest grades of Canadian "fiber."

The prices of Canadian chrysotile asbestos (f. o. b. Quebec), which control domestic prices, are shown in Figure 14. These figures are based on a balanced average of the weekly quotations of the Engineering and Mining Journal-Press. The curves are plotted on such a scale that the relative proportional change in price of any two grades is shown by comparing the slope of the curves. The method of grading asbestos is described in Mineral Resources for 1920, Part II, page 322.

The causes of the variations in the relative prices of the different grades of asbestos are to be found in the competitive conditions of world trade. Before the World War the supply for the United States came almost entirely from Quebec and that of Europe from the Ural Mountains of Russia. During the war the normal European supply from Russia was cut off, and at first the deficiency had to be made up from Canadian sources, while at the same time there was an increased demand for asbestos products. This restricted supply and strong demand led to a remarkable rise in prices, especially of "crude." The price of No. 1 "crude," which in 1913 was about $275 a ton, rose almost steadily to a maximum in the later part of 1920 and early part of 1921, when certain varieties were quoted at $3,500 a ton. During this period the exploitation of asbestos deposits in South Africa greatly increased, as shown in the table on page 349. The development of these deposits showed two phases, dependent first on the increased use of the two varieties of amphibole asbestos, crocidolite [1] (blue) and amosite (brown), and second on the discovery of deposits of high-grade long-fiber chrysotile. The South African fields are briefly described on pages 349–350. Methods of using the blue crocidolite were worked out first in Europe, where the blue fiber was mixed with the much more expensive chrysotile in some products and used alone in others. In the United States during the period of high prices the blue fiber came to be used in yarns made largely of chrysotile, but as the blue fiber requires different treatment from chrysotile and at best is inferior in high-grade textiles, it could not long compete with "crude" chrysotile, although it was instrumental in breaking the price. More important still was the development of the chrysotile deposits of southern Rhodesia and the Carolina district of Transvaal. The fiber of these deposits is of exceptional length and good quality. Although most of it is not as soft as that of Quebec, a small difference in price was all that was necessary to insure its use. The competition between the Canadian and Rhodesian chrysotile has remained so keen as to bring the price of Canadian "crude" to the point where there is little if any profit in mining it. At the same time crocidolite has come into active competition with the longer grades of Canadian milled "fiber," for in some uses the

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[1] For a brief description of the different varieties of asbestos, see U. S. Geol. Survey Mineral Resources, 1920, pt. 2, p. 311, 1923.

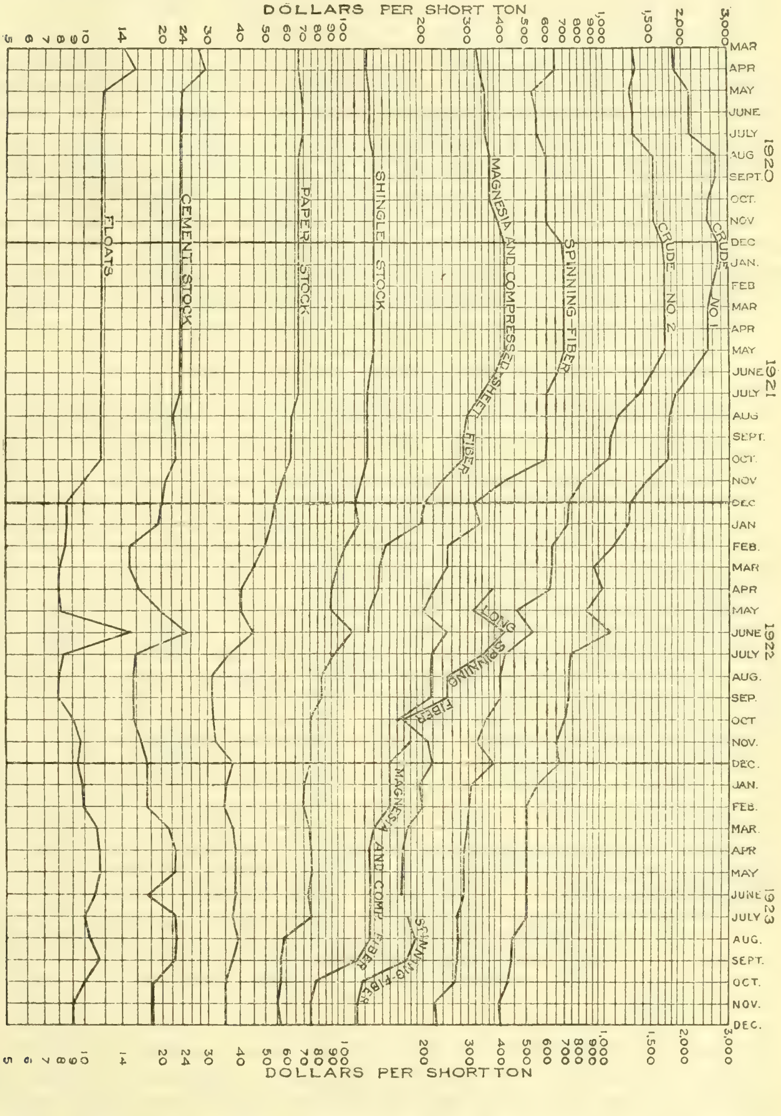

FIGURE 14.—Prices of Canadian asbestos "crude" and "fiber," f. o. b. Quebec, 1920–1923

greater length of the blue fiber more than offsets the greater softness of the equally priced grades of chrysotile. The result of this competition has placed the Canadian industry in an extremely precarious condition, which can be remedied only by an advance in the prices of the shorter grades of milled "fiber," with which there is no foreign competition. The prices of these grades have remained firm or have even shown slight advances, in spite of very keen competition between the Canadian producers themselves.

The outlook for the domestic industry may be briefly summed up. There is little prospect for a substantial advance in the prices of "crude" or the longest grades of milled "fiber." The Arizona operator can not play a waiting game. In that field conditions are now as favorable as they are likely to be in the near future, except for possible changes in the cost of mining and transportation, and these will probably not be sufficient to affect greatly the value of any property. On the other hand, the prospects for the miner of mass-fiber amphibole asbestos are exceptionally bright. The prices of Canadian fiber, with which the product will have to compete, are likely to remain firm or possibly to advance.

IMPORTS AND EXPORTS[2]

General imports of asbestos (unmanufactured), 1919–1923, in short tons

Source	1919	1920	1921	1922		1923	
				Quantity	Value	Quantity	Value
Africa:							
British South	900	2,233	504	411	$59,817	280	$33,273
Portuguese—							
East	100	1,584	279	138	33,008	1,832	288,314
Other						122	24,888
Australia		3	1	8	7,051	1	392
Brazil						([a])	43
Canada	133,662	162,717	71,412	147,596	4,745,296	208,258	6,688,142
Chile			1				
China	1	17	50	([a])	128	7	334
Czechoslovakia						([a])	58
England	156	746	200	1,273	299,358	1,760	376,306
France	450					([a])	47
Germany			11	([a])	2	148	32,376
Greece		81					
Hongkong			1				
India (British)	1					1	392
Italy		3	2	1	40	([a])	59
Japan		100	1			10	150
Netherlands						1	369
Trinidad and Tobago			1				
Turkey in Asia		74					
	135,270	167,558	72,463	149,427		212,420	
Total value	$7,369,685	$9,120,253	$2,948,302		5,144,700		7,445,143

[a] Less than 1 ton.

In the foregoing table the countries given as the sources are merely the countries from which asbestos was last shipped as shown by the invoices or manifests from which the records of imports were compiled. It is probable that Rhodesia and the Union of South Africa were the actual sources of all imports except those credited to Canada, Italy, and Brazil.

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[2] Figures for imports and exports compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce.

The exports of unmanufactured asbestos in 1923 were 680 short tons, valued at $48,525. The exports of manufactured asbestos were as follows:

Manufactured asbestos products exported from the United States in 1923

Grade	Quantity	Value
Paper, millboard, and roll board......short tons..	1, 780	$190, 755
Pipe covering and cement......do....	2, 834	426, 085
Textile yarn and packing......do....	519	672, 488
Magnesia pipe and boiler covering......do....	2, 696	337, 044
Asbestos roofing......squares..	104, 445	423, 392
Other manufactures, except roofing......short tons..	1, 625	800, 623

PRODUCTION IN FOREIGN COUNTRIES

World's production of asbestos, 1919–1923, in metric tons

Country	1919	1920	1921	1922	1923
Africa:					
Rhodesia [a]	8, 889	17, 076	17, 716	12, 926	18, 474
Union of South Africa [b]	3, 567	6, 452	4, 646	3, 981	7, 614
Australia:					
New South Wales [c]	145	675	960	570	207
South Australia [d]	----------	5	2	----------	7
Tasmania [e]	52	----------	----------	----------	----------
Western Australia [f]	54	159	239	184	117
Canada [g]	124, 070	162, 038	61, 083	145, 456	196, 680
China [h]	69	5	13	(i)	(i)
Chosen [j]	132	(i)	(i)	(i)	(i)
Cyprus [k]	1, 352	911	911	166	2, 186
Finland [l]	33	252	750	785	(i)
Germany [m]	12	28	(i)	(i)	(i)
India [n]	394	1, 847	321	246	251
Italy [o]	98	165	420	540	1, 538
New Zealand [p]	----------	2	(q)	----------	----------
Philippine Islands [r]	375	----------	----------	(i)	(i)
Russia [s]	(i)	1, 478	2, 604	3, 215	7, 153
Spain [t]	----------	----------	19	5	----------
United States	1, 053	1, 495	754	61	206
	140, 295	192, 588	90, 438	168, 135	234, 433

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[a] Southern Rhodesia Sec. Mines Ann. Repts.
[b] Sec. Mines, etc., Ann. Repts.
[c] Dept. Mines Repts.
[d] Dept. Mines, Review of mining operations.
[e] Sec. Mines Repts.
[f] 1919–1922, Sec Mines Repts.; 1923, official data furnished by Undersecretary for Mines.
[g] 1919–1920, Canada, Dept. Mines, Mines Branch, Ann. Repts. of mineral production; 1921, Dominion Bur. Statistics; 1922–1923, Quebec, Dept. Colonization, Mines, and Fisheries, Report on mining operations.
[h] 1919, Commerce Repts., Apr. 1, 1920. Figures in part estimated by U. S. Geol. Survey from values; 1920–1921, Maritime Customs, Foreign trade of China, Exports.
[i] Figures not yet available.
[j] American consul, Tokyo. Data from Japan Dept. Agr. and Commerce, Mining Bur.
[k] Official data furnished by American consul general, Cairo, Egypt.
[l] 1919, consular report, Dec. 4, 1922; 1920–1922, consular report, Oct. 29, 1923.
[m] Glückauf, Jan. 14, 1922.
[n] India Geol. Survey Records.
[o] 1919–1922, Rivista del servizio minerario; 1923, official data furnished by Ministry of National Economy.
[p] New Zealand Dept. Mines.
[q] Less than half a ton.
[r] Philippine Bur. Sci., Div. Mines, Mineral Resources.
[s] 1920–1921, Min. Jour., London, Apr. 8, 1922; 1922–1923, Gornyi Zhurnal, Nos. 3–4, 1923, and No. 3,1924.
[t] Estadística minera de España.

More asbestos was mined in 1923 than in any preceding year. The total was about 234,400 metric tons (equivalent to about 258,400 short tons). This is an increase of 39 per cent over the world's production in 1922 and of 22 per cent over the production of the previous record year, 1920. Of the total production in 1923, Canada produced 84 per cent, Rhodesia produced 8 per cent, and the Union of South Africa 3 per cent.

CANADA

The report entitled "Mining operations in the province of Quebec during the year 1923"[3] contains unusually full statistical information, as well as an excellent account of recent developments in the field. The geologic setting of the deposits and the methods of development are also briefly described. The report contains information on costs, extraction, and practice, which should be of interest to all engaged in asbestos mining in the United States. The following table is taken from this report:

Asbestos sold in the Province of Quebec in 1923

Grade	Short tons	Value	
		Total	Average
Crude No. 1	400	$189,215	$472.60
Crude No. 2	2,743	650,845	237.29
Crude run of mine	636	112,468	176.86
Spinning fiber	11,417	1,408,518	123.37
Shingle fiber	16,153	921,546	57.05
Paper stocks and others	185,455	4,081,668	22.01
	216,804	7,364,260	33.97
By-products ("sand and gravel")	16,171	17,794	1.18
	232,975	7,382,054	----------

The quantity of rock mined and hoisted during 1923 was 3,726,744 short tons, of which 3,082,394 tons was milled. The remaining rock, amounting to 17.3 per cent of the rock hoisted, was sent to the dump. The extraction of fiber was 117 pounds to the ton of rock mined and hoisted. Expressed in percentages the recovery was 5.85 per cent of the rock mined and 7.1 per cent of the rock milled. The large scale and high efficiency of the industry are shown by the fact that the average yield per ton of rock mined and hoisted was only $1.42 worth of asbestos.

SOUTH AFRICA

The size and stability of the South African asbestos industry are shown by the figures in the table on page 347. The industry in South Africa was far less affected by the post-war depression than that in Canada. Indeed, as pointed out in the section on prices, it was the ability of the South African producers to undersell the Canadians that contributed largely to the great slump in prices in 1920. The rise of the asbestos industry in South Africa is shown by the figures in the following table:

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[3] Published by the Quebec Dept. Colonization, Mines, and Fisheries, Bureau of Mines.

Asbestos shipped from mines in British South Africa, 1913–1923, in metric tons

Year	Rhodesia[a]	Transvaal[b]	Cape[b]	Natal[b]
1913	263	----------	851	22
1914	442	27	1,052	----------
1915	1,823	50	1,890	----------
1916	5,586	369	3,836	19
1917	8,674	2,897	2,721	25
1918	7,778	844	2,485	4
1919	8,889	572	2,906	89
1920	17,076	3,212	3,199	41
1921	17,716	1,445	3,145	56
1922	12,926	1,263	2,713	5
1923	18,474	3,698	3,916	----------

[a] Southern Rhodesia Sec. Mines Ann. Repts.
[b] Union South Africa Sec. Mines, etc., Ann. Repts.

The American trade commissioner at Johannesburg[4] has given an account of the South African asbestos industry which is of interest to those who follow the asbestos market in this country. Excerpts from this account follow:

The Rhodesian industry is centered so far in two fields, Shabani and Mashaba, from which the bulk of the output is being secured. There are known deposits in other sections, on the Sabi River, in the Belingwe area, in the Victoria district, in the Umvukwe Hills, in the Lomagundi section, and also in the Bubi territory. The extent of the various deposits has probably not been fully determined, although to date the big mines have been fully exploited, and their life is estimated fairly conservatively up to 50 years, although some of them are probably not good for more than half that period. It also seems likely that other deposits will be found as the country is opened up. * * *

The ownership of the principal mines is British in its capital control or joint British and South African. * * *

While Canadian short-fiber asbestos finds a ready market at home and in the United States, the South African fields, being so far removed from the world markets and having no domestic outlet of any consequence, can only market profitably the higher grades, which will stand the high transportation costs. Rhodesian asbestos is wholly chrysotile in character, although there is considerable slip fiber also found in the country. The slip fiber, which comes mainly from the Belingwe section, is of questionable value to the American user, due to its tendency to break in the course of manufacture. This is due to the lack of uniformity in its strength, the fiber running weak in spots. The continental market, including Germany and England, can take the short material for the production of slates, tiles, and similar products. It is understood that the best or longest fiber mined in Rhodesia comes from the Shabani district, where are found the two largest mines, the Shabanie and Shabanie 1 and 2 and Nil Desperandum. The fiber content of the tonnage mined runs from 2 per cent to 3 per cent, compared with the Canadian of 5 per cent to 8 per cent. The difference in length and quality in favor of the Shabani fiber fully equalizes the apparent handicap. * * *

The production within the Union of South Africa has not greatly increased within the last few years. The biggest operations have been in the Cape Province, where there are large deposits of blue asbestos, which is also known as crocidolite. The Cape Asbestos Co., a subsidiary of the De Beers Diamond Syndicate, is the largest producer, with two large mines in the Prieska and Hay districts. Considerable surface quarrying has also been carried on, and the distribution has been found to be quite irregular, but according to official statements there is no serious cause for apprehension that recovery will cease to be payable when the usual underground mining methods are adopted. * * *

Amosite asbestos is found in the Transvaal over an area 60 miles long and 3 miles wide along the Olifants River. * * * An important deposit has also been located in Seccocoeniland, and deposits in the northeastern Transvaal, near Lydenburg and Pietersburg, have been worked for some time. * * *

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[4] Stevenson, P. J., The asbestos industry in British South Africa (special report dated Aug. 9, 1922; U. S. Geol. Survey cons. file, No. 4304).

American manufacturers have had only a limited success in the use of amosite, but continental makers are reported, however, to be able to use it fairly successfully. As the cost of transportation to the Continent is less, it is probable that market will be the principal outlet for amosite.

Chrysotile asbestos was secured for some time from the Carolina district in the Transvaal, but these high-grade fibers are no longer available, as the mines have been worked out. It is stated by a well-informed authority that these fibers were the best sent to the American market from Africa. Their place will apparently be taken by the product of the Amianthus mine, at Godwan River. The fiber from this mine is long chrysotile, and the deposit is exceptionally rich, the rock yielding up to 40 per cent fiber. This deposit has also the advantage of being located on the railway and is not far from the port of Lourenço Marques.

There are a few deposits of chrysotile in Natal, but they are not yet of any commercial importance. There are also good deposits of chrysotile in the Barberton district near Kaapsche Hoop. While the whole of this field has not been proved it is evident that the prospects of this section are promising.

CYPRUS

The Cyprus Asbestos Co., which in 1922 was preparing for a greatly increased development of this field, operated at a loss in 1923 but is continuing operations.

NATURAL GAS

By G. B. Richardson

All records were broken in the natural-gas industry in the United States in 1923 by the consumption of 1,008,135,000,000 cubic feet, which had an estimated value of $101,000,000 at the wells and of $240,000,000 at points of consumption. This quantity is 32 per cent more than that consumed in 1922 and 26 per cent more than that consumed in 1920, when the previous high record of consumption was attained.

Increased production, as measured by deliveries to consumers, is recorded for most of the States, and Oklahoma, California, and Louisiana showed gains ranging between 42 and 63 billion cubic feet. In California enormous quantities of natural gas, associated with petroleum, were produced in the development of the Santa Fe Springs, Long Beach, and Huntington Beach fields, but the greater part of the gas produced in these fields was wasted. Operators reported to the Geological Survey a production of 248 billion cubic feet of gas in California, but of this amount only 131 billion cubic feet was delivered to consumers.

Industrial consumption of natural gas increased to 72 per cent of the total, the increase being chiefly in field consumption and in the manufacture of carbon black, and the average value of natural gas used for industrial purposes decreased from 18.6 cents a thousand cubic feet at points of consumption in 1922 to 13.4 cents in 1923. Although the ratio of domestic to total consumption decreased, the number of domestic consumers increased 219,200 during the year, bringing the total to 3,234,000, and the average value of natural gas used for domestic purposes increased from 49.9 cents at points of consumption in 1922 to 51.1 cents in 1923.

The interstate movement of natural gas increased from 179 billion cubic feet in 1922 to almost 190 billion cubic feet in 1923. West Virginia, which contributed over 20 per cent of the total credited to production and consumed less than 9 per cent, contributed 63 per cent of the total interstate movement of natural gas.

The following tables were compiled by H. Backus.

Summary of statistics for natural gas, 1919–1923

	1919	1920	1921	1922	1923
Natural gas consumed:					
Domestic millions of cubic feet	255,743	286,001	248,334	254,413	278,218
Industrial—					
Carbon black do	49,896	40,599	50,565	53,629	109,096
Field do	169,787	202,108	182,305	197,850	343,076
Other industrial do	270,490	269,502	180,848	256,654	277,745
	745,916	798,210	662,052	762,546	1,008,135
Domestic per cent	34.3	35.8	37.5	33.4	27.6
Industrial do	65.7	64.2	62.5	66.6	72.4
Treated for natural-gas gasoline:					
Millions of cubic feet	480,404	496,431	465,097	545,139	875,711
Per cent of total consumption	64.4	62.2	70.3	71.5	86.9
Domestic consumers thousands	2,501	2,615	2,631	3,015	3,234
Value of natural gas at wells:					
Total thousands of dollars	(a)	(a)	(a)	84,873	100,959
Average per M cubic feet cents	(a)	(a)	(a)	11.1	10.0
Value of natural gas at points of consumption:					
Total thousands of dollars	160,888	196,194	174,617	221,535	239,966
Domestic do	88,414	109,302	110,337	126,902	142,288
Industrial do	72,474	86,892	64,280	94,633	97,678
Average per M cubic feet—					
Domestic cents	34.6	38.2	44.4	49.9	51.1
Industrial do	14.8	17.0	15.5	18.6	13.4
Domestic and industrial do	21.6	24.6	26.4	29.1	23.8
By-products of natural gas:					
Natural-gas gasoline (raw)—					
Quantity thousands of gallons	351,500	384,700	449,900	505,800	816,200
Value at plants:					
Total thousands of dollars	64,197	71,788	61,815	72,711	77,268
Average per gallon cents	18.3	18.7	13.7	14.4	9.5
Carbon black:					
Quantity thousands of pounds	52,100	51,300	59,800	67,800	138,300
Value at plants:					
Total thousands of dollars	3,816	4,032	5,446	5,820	11,692
Average per pound cents	7.3	7.9	9.1	8.6	8.5

[a] Figures not available.

Natural gas produced and consumed in the United States, 1922–23

State	Produced and delivered to consumers, including deliveries in other States						Consumed, including receipts from other States			
	Quantity		Estimated value at the wells		Value at points of consumption		Quantity		Value at points of consumption	
	M cubic feet	Per cent of total	Total	Average per M cubic feet (cents)	Total	Average per M cubic feet (cents)	M cubic feet	Per cent of total	Total	Average per M cubic feet (cents)
1922										
Ark	9,700,000	1.3	$873,000	9.0	$1,798,000	18.5	17,826,000	2.3	$3,306,000	18.5
Calif	84,580,000	11.1	7,612,000	9.0	17,898,000	21.2	84,580,000	11.1	17,898,000	21.2
Colo	4,000	(a)	400	10.0	560	14.0	4,000	(a)	560	14.0
Ill	3,383,000	.4	372,100	11.0	424,040	12.5	3,383,000	.4	424,040	12.5
Ind	947,000	.1	284,100	30.0	476,172	50.3	3,263,000	.4	1,641,000	50.3
Iowa	500	(a)	56	11.2	250	50.0	500	(a)	250	50.0
Kans	20,289,000	2.7	1,826,000	9.0	9,123,000	45.0	28,348,000	3.7	10,315,000	36.4
Ky	5,872,000	.8	646,000	11.0	1,879,000	32.0	15,268,000	2.0	4,884,000	32.0
La	70,267,000	9.2	2,108,000	3.0	5,849,000	8.3	65,987,000	8.7	4,476,000	6.8
Md	------------	-----	------------	-----	------------	-----	705,000	.1	472,000	67.0
Mich	700	(a)	78	11.1	350	50.0	700	(a)	350	50.0
Mo	2,600	(a)	289	11.1	2,028	78.0	4,873,600	.6	3,802,000	78.0
Mont	486,000	(a)	24,245	5.0	88,300	18.2	486,000	(a)	88,300	18.2
N. Y	6,947,000	.9	1,598,000	23.0	3,379,000	48.6	15,777,000	2.1	7,676,000	48.7
N. Dak	600	(a)	67	11.1	300	50.0	600	(a)	300	50.0
Ohio	51,481,000	6.7	9,267,000	18.0	24,181,000	47.0	116,127,000	15.2	55,062,000	47.4
Okla	140,631,000	18.4	15,469,000	11.0	33,475,800	23.8	111,681,000	14.6	24,800,000	22.2
Pa	101,276,000	13.3	20,255,000	20.0	39,835,000	39.3	130,733,000	17.2	50,657,000	38.7
S. Dak	15,600	(a)	1,732	11.1	6,400	41.0	15,600	(a)	6,400	41.0
Tenn	3,000	(a)	333	11.1	800	26.7	3,000	(a)	800	26.7
Tex	47,945,000	6.3	3,835,600	8.0	10,623,000	22.2	60,119,000	7.9	14,165,000	23.6
W. Va	195,288,000	25.6	19,529,000	10.0	69,464,000	35.6	79,938,000	10.5	18,829,000	23.6
Wyo	23,427,000	3.1	1,171,000	5.0	3,031,000	12.9	23,427,000	3.1	3,031,000	12.9
	762,546,000	100.0	84,873,000	11.1	221,535,000	29.1	762,546,000	100.0	221,535,000	29.1
1923										
Ark	24,215,000	2.4	990,000	4.1	3,255,000	13.4	33,746,000	3.4	4,536,000	13.4
Calif	131,434,000	13.0	8,543,000	6.5	22,787,000	17.3	131,434,000	13.0	22,787,000	17.3
Colo	800	(a)	80	10.0	400	50.0	800	(a)	400	50.0
Ill	4,049,000	.4	587,000	14.5	690,000	17.0	4,049,000	.4	690,000	17.0
Ind	880,000	.1	286,000	32.5	460,000	52.3	2,951,000	.3	1,553,000	52.6
Kans	32,072,000	3.2	2,707,000	8.4	11,304,000	35.2	37,637,000	3.7	10,829,000	28.8
Ky	11,953,000	1.2	1,039,000	8.7	3,156,000	26.4	21,232,000	2.1	5,605,000	26.4
La	112,031,000	11.1	2,890,000	2.6	6,022,000	5.4	111,434,000	11.1	5,127,000	4.6
Md	------------	-----	------------	-----	------------	-----	668,000	.1	486,000	72.8
Mich	700	(a)	80	11.4	320	45.7	700	(a)	320	45.7
Mo	17,000	(a)	3,000	17.6	12,000	70.6	6,301,000	.6	4,152,000	65.9
Mont	1,470,000	.2	59,000	4.0	317,000	21.6	2,417,000	.3	521,000	21.6
N. Y	6,497,000	.7	1,648,000	25.4	3,739,000	57.5	16,495,000	1.6	9,506,000	57.6
Ohio	53,812,000	5.3	8,395,000	15.6	25,675,000	47.7	120,920,000	12.0	58,468,000	48.4
Okla	203,082,000	20.1	18,277,000	9.0	31,126,000	15.3	173,788,000	17.3	24,631,000	14.2
Pa	112,562,000	11.2	25,887,000	23.0	45,873,000	40.8	138,478,000	13.7	54,742,000	39.5
S. Dak	33,000	(a)	3,000	9.1	16,600	50.3	33,000	(a)	16,600	50.3
Tenn	4,100	(a)	300	7.3	1,000	24.4	4,100	(a)	1,000	24.4
Tex	74,535,000	7.4	3,809,000	5.1	11,320,000	15.2	[c] 83,046,000	8.2	13,763,000	16.6
W. Va	203,867,000	20.2	24,403,000	12.0	69,981,000	34.3	88,827,000	8.8	18,525,000	20.9
Wyo	35,523,000	3.5	1,424,000	4.0	4,222,000	11.9	34,576,000	3.4	4,018,000	11.6
Other [b]	97,400	(a)	8,540	8.8	8,680	8.9	97,400	(a)	8,680	8.9
	1,008,135,000	100.0	100,959,000	10.0	239,966,000	23.8	[c]1,008,135,000	100.0	239,966,000	23.8

[a] Less than 0.1 per cent.

[b] Alaska, Iowa, New Mexico, and North Dakota.

[c] Includes 9,000 M cubic feet consumed in Mexico.

Interstate transportation of natural gas, 1922–23

State in which gas was produced	State to which gas was transported	M cubic feet	State in which gas was produced	State to which gas was transported	M cubic feet
1922			**1923**		
Indiana	Kentucky	4,000	Indiana	Kentucky	12,000
Kansas	Missouri	4,327,000	Kansas	Missouri	5,725,000
	Oklahoma	425,000		Oklahoma	337,000
		4,752,000			6,062,000
Louisiana	Arkansas	6,123,000	Louisiana	Arkansas	7,625,000
	Texas	2,169,000		Texas	1,615,000
		8,292,000			9,240,000
New York	Pennsylvania	19,000	New York	Pennsylvania	34,000
Ohio	Indiana	2,320,000	Ohio	Indiana	2,083,000
	West Virginia	1,234,000		West Virginia	1,579,000
		3,554,000			3,662,000
Oklahoma	Arkansas	2,003,000	Oklahoma	Arkansas	1,906,000
	Kansas	12,811,000		Kansas	11,627,000
	Missouri	544,000		Missouri	559,000
	Texas	14,017,000		Texas	15,539,000
		29,375,000			29,631,000
Pennsylvania	New York	8,849,000	Pennsylvania	New York	10,032,000
	Ohio	71,000		Ohio	67,000
	West Virginia	1,910,000		West Virginia	2,381,000
		10,830,000			12,480,000
Texas	Louisiana	4,012,000	Texas	Louisiana	8,643,000
				Mexico	9,000
					8,652,000
West Virginia	Kentucky	9,392,000	West Virginia	Kentucky	9,267,000
	Maryland	705,000		Maryland	668,000
	Ohio	68,129,000		Ohio	70,703,000
	Pennsylvania	40,268,000		Pennsylvania	38,362,000
		118,494,000			119,000,000
			Wyoming	Montana	947,000
		179,332,000			189,720,000

Natural gas consumed in the United States in 1922

State	Domestic				Industrial								
					Field (drilling, pumping, and operating gasoline extraction plants)			Other industrial, including use in manufacture of carbon black			Total industrial		
	Number of consumers	M cubic feet	Value at points of consumption		M cubic feet (estimated)	Value at points of consumption		M cubic feet	Value at points of consumption		M cubic feet	Value at points of consumption	
			Total	Average (cents)		Total (estimated)	Average (cents)		Total	Average (cents)		Total	Average (cents)
Arkansas	32, 100	4, 423, 000	$1, 637, 000	37. 0	5, 343, 000	$352, 000	6. 6	8, 060, 000	$1, 317, 000	16. 3	13, 403, 000	$1, 669, 000	12. 5
California	428, 960	12, 802, 000	10, 056, 000	78. 6	47, 655, 000	3, 515, 000	7. 4	24, 123, 000	4, 326, 000	17. 9	71, 778, 000	7, 841, 000	10. 9
Colorado	7	4, 000	560	14. 0									
Illinois	8, 900	286, 000	140, 840	49. 2	3, 067, 000	277, 000	9. 0	30, 000	6, 200	20. 7	3, 097, 000	283, 200	9. 1
Indiana	39, 120	1, 767, 000	1, 075, 800	60. 9	85, 000	20, 000	23. 5	1, 411, 000	545, 200	38. 6	1, 496, 000	565, 200	37. 8
Iowa	3	500	250	50. 0									
Kansas	128, 580	11, 518, 000	7, 166, 000	62. 2	3, 801, 000	653, 000	17. 2	13, 029, 000	2, 496, 000	19. 2	16, 830, 000	3, 149, 000	18. 7
Kentucky	111, 595	9, 649, 000	3, 984, 000	41. 3	535, 000	101, 000	18. 9	5, 084, 000	799, 000	15. 7	5, 619, 000	900, 000	16. 0
Louisiana	26, 070	3, 383, 000	1, 006, 000	29. 7	18, 429, 000	1, 718, 000	9. 3	44, 175, 000	1, 752, 000	4. 0	62, 604, 000	3, 470, 000	5. 5
Maryland	11, 045	568, 000	399, 000	70. 2				137, 000	73, 000	53. 3	137, 000	73, 000	53. 3
Michigan	9	700	350	50. 0									
Missouri	85, 600	4, 639, 600	3, 732, 000	80. 4				234, 000	70, 000	29. 9	234, 000	70, 000	29. 9
Montana	1, 230	148, 000	79, 600	53. 8	15, 000	2, 000	13. 3	323, 000	6, 700	2. 1	338, 000	8, 700	2. 6
New York	174, 070	15, 115, 000	7, 422, 000	49. 1	262, 000	38, 000	14. 5	400, 000	216, 000	54. 0	662, 000	254, 000	38. 4
North Dakota	3	600	300	50. 0									
Ohio	984, 300	84, 176, 000	41, 966, 000	49. 9	2, 880, 000	936, 000	32. 5	29, 071, 000	12, 160, 000	41. 8	31, 951, 000	13, 096, 000	41. 0
Oklahoma	136, 600	17, 403, 000	7, 558, 000	43, 4	56, 208, 000	11, 768, 000	20. 9	38, 070, 000	5, 475, 000	14. 4	94, 278, 000	17, 243, 000	18. 3
Pennsylvania	534, 100	54, 984, 000	27, 066, 000	49. 2	4, 900, 000	1, 182, 000	24. 1	70, 849, 000	22, 409, 000	31. 6	75, 749, 000	23, 591, 000	31. 1
South Dakota	365	10, 200	5, 100	50. 0				5, 400	1, 300	24. 1	5, 400	1, 300	24. 1
Tennessee	3	400	200	50. 0				2, 600	600	23. 1	2, 600	600	23. 1
Texas	157, 530	11, 331, 000	6, 946, 000	61. 3	36, 288, 000	5, 003, 000	13. 8	12, 500, 000	2, 216, 000	17. 7	48, 788, 000	7, 219, 000	14. 8
West Virginia	146, 430	20, 742, 000	6, 114, 000	29. 5	8, 867, 000	1, 497, 000	16. 9	50, 329, 000	11, 218, 000	22. 3	59, 196, 000	12, 715, 000	21. 5
Wyoming	7, 980	1, 462, 000	547, 000	37. 4	9, 515, 000	382, 000	4. 0	12, 450, 000	2, 102, 000	16. 9	21, 965, 000	2, 484, 000	11. 3
	3, 014, 600	254, 413, 000	126, 902, 000	49. 9	197, 850, 000	27, 444, 000	13. 9	310, 283, 000	67, 189, 000	21. 7	508, 133, 000	94, 633, 000	18. 6

Natural gas consumed in the United States in 1923

State	Domestic				Industrial							
	Number of consumers	M cubic feet	Value at points of consumption		Field (drilling, pumping, and operating gasoline extraction plants)		Other industrial, including use in manufacture of carbon black			Total industrial		
			Total	Average (cents)	M cubic feet (estimated)	Value at points of consumption (estimated)	M cubic feet	Value at points of consumption		M cubic feet	Value at points of consumption	
								Total	Average (cents)		Total	Average (cents)
Arkansas	38, 280	5, 670, 000	$2, 105, 000	37. 1	18, 320, 000	$749, 000	9, 756, 000	$1, 682, 000	17. 2	28, 076, 000	$2, 431, 000	8. 7
California	511, 590	16, 642, 000	12, 525, 000	75. 3	86, 101, 000	5, 596, 000	28, 691, 000	4, 666, 000	16. 3	114, 792, 000	10, 262, 000	8. 9
Colorado	8	800	400	50. 0								
Illinois [a]	10, 500	216, 000	134, 000	62. 0	3, 833, 000	556, 000				3, 833, 000	556, 000	14. 5
Indiana	36, 300	1, 624, 000	936, 000	57. 6	47, 000	15, 000	1, 280, 000	602, 000	47. 0	1, 327, 000	617, 000	46. 5
Kansas	130, 830	10, 462, 000	6, 302, 000	60. 2	4, 844, 000	409, 000	22, 331, 000	4, 118, 000	18. 4	27, 175, 000	4, 527, 000	16. 7
Kentucky	116, 570	10, 897, 000	4, 328, 000	39. 7	1, 193, 000	104, 000	9, 142, 000	1, 173, 000	12. 8	10, 335, 000	1, 277, 000	12. 4
Louisiana	26, 730	3, 264, 000	1, 020, 000	31. 3	13, 880, 000	358, 000	94, 290, 000	3, 749, 000	4. 0	108, 170, 000	4, 107, 000	3. 8
Maryland	11, 290	587, 000	443, 000	75. 5			81, 000	43, 000	53. 1	81, 000	43, 000	53. 1
Michigan	10	700	320	45. 7								
Missouri	93, 070	6, 042, 000	4, 056, 440	67. 1			259, 000	95, 560	36. 9	259, 000	95, 560	36. 9
Montana	5, 170	1, 083, 000	482, 000	44. 5	520, 000	20, 000	814, 000	19, 000	2. 3	1, 334, 000	39, 000	2. 9
New York	197, 540	16, 009, 000	9, 300, 000	58. 1	217, 000	55, 000	269, 000	151, 000	56. 1	486, 000	206, 000	42. 4
Ohio	1, 023, 730	91, 702, 000	46, 553, 000	50. 8	4, 714, 000	735, 000	24, 504, 000	11, 180, 000	45. 6	29, 218, 000	11, 915, 000	40. 8
Oklahoma	142, 700	17, 496, 000	8, 436, 000	48. 2	114, 948, 000	10, 345, 000	41, 344, 000	5, 850, 000	14. 1	156, 292, 000	16, 195, 000	10. 4
Pennsylvania	548, 440	58, 968, 000	29, 614, 000	50. 2	10, 027, 000	2, 304, 000	69, 483, 000	22, 824, 000	32. 8	79, 510, 000	25, 128, 000	31. 6
South Dakota	380	33, 000	16, 600	50. 3								
Tennessee	2	100	60	60. 0			4, 000	940	23. 5	4, 000	940	23. 5
Texas	177, 070	13, 002, 000	8, 406, 000	64. 7	51, 876, 000	2, 651, 000	18, 159, 000	2, 700, 000	14. 9	70, 035, 000	5, 351, 000	7. 6
West Virginia	154, 060	22, 806, 000	6, 884, 000	30. 2	20, 252, 000	2, 424, 000	45, 769, 000	9, 217, 000	20. 1	66, 021, 000	11, 641, 000	17. 6
Wyoming	9, 350	1, 632, 000	734, 000	45. 0	12, 279, 000	493, 000	20, 665, 000	2, 791, 000	13. 5	32, 944, 000	3, 284, 000	10. 0
Other [b]	180	72, 400	6, 180	8. 5	25, 000	2, 500				25, 000	2, 500	10. 0
	3, 233, 800	[c] 278, 209, 000	142, 282, 000	51. 1	343, 076, 000	26, 816, 500	386, 841, 000	70, 861, 500	18. 3	729, 917, 000	97, 678, 000	13. 4

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[a] Gas used with manufactured gas.

[b] Alaska, Iowa, New Mexico, and North Dakota.

[c] Exclusive of 9,000 M cubic feet consumed in Mexico.

Rank of States in production and consumption of natural gas, 1919–1923

State	Utilized production					Consumption				
	1919	1920	1921	1922	1923	1919	1920	1921	1922	1923
Alaska	------	------	------	------	18	------	------	------	------	20
Arkansas	11	10	12	10	10	10	10	12	10	10
California	5	4	4	4	3	5	5	5	4	3
Colorado	18	18	18	17	21	20	20	20	19	22
Illinois	12	13	13	13	13	15	15	15	14	14
Indiana	14	14	14	14	15	14	14	14	15	15
Iowa	22	21	21	22	24	23	22	22	23	25
Kansas	8	8	8	9	9	6	8	8	8	8
Kentucky	13	12	11	12	11	11	11	11	12	11
Louisiana	6	6	5	5	5	8	7	6	6	5
Maryland	23	23	23	------	------	17	17	16	16	17
Michigan	21	22	22	20	22	22	23	23	21	23
Missouri	19	19	18	19	19	13	13	13	13	13
Montana	15	15	15	15	14	16	16	17	17	16
New Mexico	------	------	------	------	16	------	------	------	------	18
New York	9	11	10	11	12	9	9	10	11	12
North Dakota	20	20	20	21	23	21	21	21	22	24
Ohio	4	5	6	6	7	2	2	1	2	4
Oklahoma	2	2	2	2	2	3	3	2	3	1
Oregon	23	23	23	------	------	24	24	24	------	------
Pennsylvania	3	3	3	3	4	1	1	3	1	2
South Dakota	17	16	17	16	17	19	18	19	18	19
Tennessee	16	17	16	18	20	18	19	18	20	21
Texas	7	7	7	7	6	7	6	7	7	7
West Virginia	1	1	1	1	1	4	4	4	5	6
Wyoming	10	9	9	8	8	12	12	9	9	9

Natural gas produced and delivered to consumers in the United States, 1914–1923, in millions of cubic feet

Year	Arkansas	California	Illinois	Indiana	Kansas	Kentucky	Louisiana	Montana	New York	Ohio
1914	[a] 963	17,829	3,548	2,580	22,628	1,422	[b] 26,775	--------	8,935	68,270
1915	[c] 992	21,891	2,690	2,261	27,046	1,667	25,540	6	7,977	79,510
1916	2,388	31,643	3,534	1,715	31,710	2,107	32,081	213	8,036	69,888
1917	5,610	49,427	4,439	1,712	24,439	2,802	31,287	334	8,372	68,917
1918	5,295	39,719	4,473	1,667	27,825	3,022	36,094	177	8,461	61,261
1919	5,587	55,607	3,825	1,407	16,150	2,057	47,062	858	8,124	63,153
1920	9,027	66,041	3,013	1,779	21,158	3,345	58,274	818	8,419	58,938
1921	4,260	75,942	2,646	1,066	15,717	4,820	58,004	336	6,583	47,412
1922	9,700	84,580	3,383	947	20,289	5,872	70,267	486	6,947	51,481
1923	24,215	131,434	4,049	880	32,072	11,953	112,031	1,470	6,497	53,812

Year	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Others	Total	Value at points of consumption		Energy equivalent (billions of British thermal units)[d]
								Total (thousands of dollars)	Average per M cubic feet (cents)	
1914	78,167	110,745	13,434	236,489	([a])	82	591,867	94,116	15.9	636,257
1915	87,517	113,692	13,324	244,004	[e] 342	120	628,579	101,312	16.1	675,722
1916	123,517	130,484	15,810	299,319	[e] 575	150	753,170	120,227	16.0	809,658
1917	137,384	133,397	17,047	308,617	[e] 1,223	103	795,110	142,089	17.9	854,743
1918	124,317	123,813	13,440	265,161	4,339	1,937	721,001	153,554	21.3	775,076
1919	163,649	113,489	24,710	234,095	6,014	129	745,916	160,888	21.6	801,860
1920	154,467	125,787	37,063	239,719	10,312	50	798,210	196,194	24.6	858,076
1921	124,058	86,144	44,504	174,921	15,608	31	662,052	174,617	26.4	711,706
1922	140,631	101,276	47,945	195,288	23,427	27	762,546	221,535	29.1	819,737
1923	203,082	112,562	74,535	203,867	35,523	153	1,008,135	239,966	23.8	1,083,745

[a] Colorado and Wyoming included with Arkansas.
[b] Alabama included with Louisiana.
[c] Includes gas piped from Oklahoma and consumed in Arkansas.
[d] Revised estimates based on heating value of 1,075 British thermal units per cubic foot.
[e] Includes Colorado.

Statistics of natural gas, 1914–1923

Year	Produced and delivered to consumers (billions of cubic feet)	Treated for extraction of natural-gas gasoline		Domestic consumption			
		Billions of cubic feet	Per cent of total consumption	Number of consumers (thousands)	Billions of cubic feet	Per cent of total consumption	Average value at points of consumption per M cubic feet (cents)
1914	592	17	3	2,078	203	34	28.0
1915	629	24	4	2,195	217	35	28.3
1916	753	209	28	2,362	235	31	28.6
1917	795	429	54	2,431	258	32	30.8
1918	721	449	62	2,509	271	38	31.4
1919	746	480	64	2,501	256	34	34.6
1920	798	496	62	2,615	286	36	38.2
1921	662	465	70	2,631	248	38	44.4
1922	763	545	71	3,015	255	33	49.9
1923	1,008	876	87	3,234	278	28	51.1

Year	Industrial consumption					
	Field (billions of cubic feet)	Carbon black (billions of cubic feet)	Other (billions of cubic feet)	Total (billions of cubic feet)	Per cent of total consumption	Average value at points of consumption per M cubic feet (cents)
1914	(a)	(a)	(a)	389	66	9.6
1915	(a)	(a)	(a)	412	65	9.7
1916	(a)	(a)	(a)	518	69	10.2
1917	(a)	(a)	(a)	537	68	11.7
1918	(a)	(a)	(a)	450	62	15.2
1919	170	50	270	490	66	14.8
1920	202	41	269	512	64	17.0
1921	182	51	181	414	62	15.5
1922	198	54	256	508	67	18.6
1923	343	109	278	730	72	13.4

[a] Figures not available.

NATURAL-GAS GASOLINE

By G. B. Richardson

A total of 816,226,000 gallons of raw (unblended) natural-gas gasoline, having a value at the plants of $77,268,000, was produced in the United States in 1923. This output, an increase of 61 per cent over that of 1922, was more than double that of 1920, and the year's increase of 310 million gallons is more than the total production of the country in 1918. Notwithstanding an increase of 22 per cent in the quantity of gasoline produced from petroleum in 1923, the quantity of gasoline produced from natural gas was equivalent to approximately 11 per cent of the quantity of gasoline produced from petroleum, as contrasted with 8 per cent in 1922.

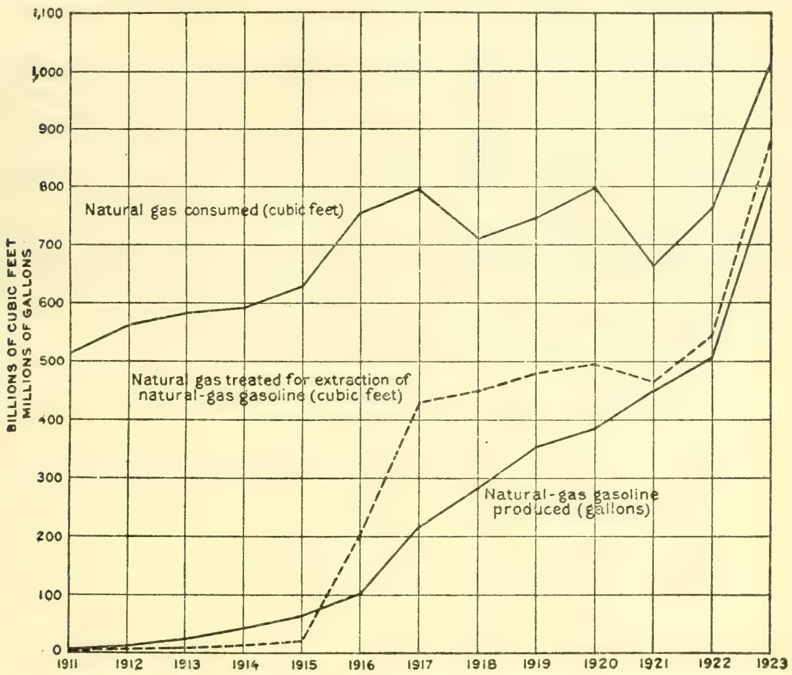

FIGURE 15.—Natural-gas gasoline produced, total quantity of natural gas consumed, and portion treated for the extraction of gasoline, 1911–1923

The rank of the four leading States—Oklahoma, Texas, California, and West Virginia—remained the same as in 1921 and 1922, although Oklahoma's output has increased 43 per cent and that of West Virginia only 12 per cent over that of 1922, whereas the output of Texas has increased 86 per cent and that of California 158 per cent.

The increased production of natural-gas gasoline in California followed the development of the new fields in the Los Angeles Basin, in which great quantities of natural gas were produced with the petroleum, but only a fraction of the gas available was utilized, and large quantities, both before and after the extraction of gasoline, were not consumed.

During 1923 the number of compression plants decreased and the number using the oil-absorption process, both singly and in combination with the compression process, increased; the new charcoal process, by which natural gas is brought into intimate contact with activated charcoal, in the capillaries of which the vapors are condensed, was reported in use by 10 plants. The increased average capacity of the plants now in operation, contrasted with those of five years ago, is emphasized by the fact that although the total number of plants operated in 1918 and 1923 was about the same, 1,067 in 1923 and 1,004 in 1918, the output in 1923 was almost three times that in 1918.

The quantity of natural gas treated in the recovery of the natural-gas gasoline produced in 1923 was equivalent to 87 per cent of the total quantity of natural gas consumed in the United States, as contrasted with 71 per cent in 1922, 54 per cent in 1917, and 2 per cent in 1913. These figures not only show the growth of the industry from another viewpoint and the increasing conservation of natural gas, but they indicate the near approach of the time when the available annual supply of gas, which heretofore has been much in excess of the quantity treated for the extraction of gasoline, will be a controlling factor in the growth of the industry.

The following tables were compiled by E. M. Seeley.

Natural-gas gasoline produced in the United States in 1922 and 1923, by States

State	Number of operators reporting[a]	Number of plants	Raw (unblended) gasoline produced			Estimated quantity of natural gas treated	
			Thousands of gallons	Value at plant			
				Thousands of dollars	Average per gallon (cents)	Millions of cubic feet	Average yield per M cubic feet (gallons)
1922							
Oklahoma	103	267	189,404	24,914	13.2	94,800	2.0
Texas	24	56	95,405	12,115	12.7	51,243	1.9
California	31	77	67,120	11,868	17.7	61,995	1.1
West Virginia	59	151	56,796	9,771	17.2	163,139	.3
Louisiana	15	26	29,406	4,113	14.0	47,144	.6
Wyoming	4	5	19,967	2,251	11.3	6,344	3.1
Pennsylvania	135	195	18,518	3,145	17.0	51,329	.4
Ohio	25	41	8,600	1,301	15.1	37,137	.2
Illinois	32	78	7,760	1,182	15.2	3,231	2.4
Kentucky	6	8	5,205	926	17.8	18,123	.3
Arkansas	1	1	4,289	629	14.7	1,194	3.6
Kansas	6	8	2,856	435	15.2	8,188	.3
New York	4	4	506	61	12.1	1,272	.4
	[a] 402	917	505,832	72,711	14.4	545,139	.9
1923							
Oklahoma	108	279	270,249	23,012	8.5	136,563	2.0
Texas	48	100	177,765	14,752	8.3	113,733	1.6
California	57	119	173,329	16,564	9.6	211,409	.8
West Virginia	58	162	63,381	8,890	14.0	164,906	.4
Louisiana	25	35	40,720	3,484	8.6	87,944	.5
Wyoming	8	10	21,292	1,992	9.4	24,523	.9
Pennsylvania	127	196	19,132	2,560	13.4	55,238	.3
Arkansas	4	7	16,183	1,916	11.8	3,975	4.1
Ohio	25	44	10,035	1,446	14.4	39,805	.3
Kansas	7	13	8,775	690	7.9	10,843	.8
Kentucky	9	11	7,601	1,067	14.0	22,925	.3
Illinois	30	86	7,356	851	11.6	3,207	2.3
New York	5	5	408	44	10.8	640	.6
	[a] 455	1,067	816,226	77,268	9.5	875,711	.9

[a] A producer operating in more than one State is counted only once.

Natural-gas gasoline produced in the United States in 1922 and 1923, by methods of manufacture

State	Number of plants reported				Raw (unblended) gasoline produced (thousands of gallons)				
	Compression	Oil absorption	Combination (compression and oil absorption)	Charcoal	Compression	Oil absorption	Combination (compression and oil absorption)	Charcoal	Drip
1922									
Oklahoma	197	[a] 62	[a] 8		[a] 137, 712	[a] 41, 335	[a] 9, 688		669
Texas	34	[a] 15	[a] 7		[a] 62, 794	[a] 11, 810	[a] 20, 616		185
California	27	36	14		22, 558	23, 958	20, 314		290
West Virginia	85	56	10		12, 591	41, 090	2, 906		209
Louisiana	13	10	3		8, 998	13, 016	6, 925		467
Wyoming	4	1			19, 869	98			
Pennsylvania	168	27			9, 116	9, 345			57
Ohio	29	12			1, 334	7, 253			13
Illinois	78				7, 752				8
Kentucky	5	3			561	4, 644			
Arkansas			1				4, 289		
Kansas	5	3			909	1, 928			19
New York	3	1			281	225			
	648	[a] 226	[a] 43	([b])	[a] 284, 475	[a] 154, 702	[a] 64, 738	([b])	1, 917
1923									
Oklahoma	178	77	24		138, 455	99, 924	31, 067		803
Texas	42	45	13		80, 033	54, 436	43, 267		29
California	20	79	20		14, 937	128, 489	29, 903		
West Virginia	68	52	39	3	8, 627	41, 019	12, 259	1, 186	296
Louisiana	13	16	5	1	9, 317	24, 945	5, 961	497	
Wyoming	4	5	1		17, 718	3, 337	137		100
Pennsylvania	168	21	6	[c] 3	7, 943	6, 995	3, 409	712	73
Arkansas		5	2			5, 579	10, 510		94
Ohio	29	14	1		1, 251	8, 544	233		7
Kentucky	3	4	1	3	462	6, 562	41	536	
Kansas	5	8			4, 459	4, 301			15
Illinois	86				7, 355				1
New York	4	1			315	93			
	620	327	112	[c] 10	290, 872	384, 224	136, 787	2, 931	1, 412

[a] Revised figures.
[b] Included under oil absorption.
[c] Two of the charcoal plants run in connection with others.

Natural-gas gasoline turned into crude-petroleum pipe lines in 1923, by States [a]

State	Gallons	State	Gallons
California	50, 397, 785	Texas	3, 529, 365
Illinois	26, 430	West Virginia	25, 124
Louisiana	3, 048, 871	Wyoming	1, 837, 629
Oklahoma	15, 418, 235		
Pennsylvania	251, 611		74, 535, 050

[a] Included in figures of production. Corresponding data for preceding years not available.

Natural-gas gasoline produced in the United States, 1911–1923, by States, in thousands of gallons

Year	Arkansas	California	Colorado	Illinois	Kansas	Kentucky	Louisiana	New York	Ohio
1911		([a])	([a])	([a])		([a])		([a])	1,679
1912		1,041	([a])	([a])		([a])		([a])	1,719
1913		3,461	([a])	([a])	([a])	([a])		([a])	2,073
1914		7,581	([a])	1,164	([a])	([a])		([a])	2,440
1915		12,835	([a])	1,035	([a])	([a])	([a])	([a])	2,199
1916		17,159	([a])	2,260	215	725	2,113	([a])	2,639
1917		28,818	([a])	4,934	1,175	3,818	4,980	([a])	5,440
1918		32,269	2	4,575	2,390	3,331	7,021	218	6,745
1919		40,386		6,060	3,284	5,136	10,063	458	8,801
1920		48,208		6,055	4,331	4,497	10,610	411	10,016
1921		58,220		7,536	3,587	4,242	15,341	366	9,100
1922	4,289	67,120		7,760	2,856	5,205	29,406	506	8,600
1923	16,183	173,329		7,356	8,775	7,601	40,720	408	10,035
	20,472	490,427	([a])	48,735	26,613	34,555	120,254	2,367	71,486
Percentage of total	0.6	15.0		1.5	0.8	1.1	3.7	0.1	2.2

Year	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Miscellaneous	Total	Value at plant	
								Thousands of dollars	Average per gallon (cents)
1911	388	1,467		3,660		232	7,426	532	7.2
1912	1,575	2,041		5,318		387	12,081	1,157	9.6
1913	6,463	3,680		7,662		722	24,061	2,458	10.2
1914	17,278	4,612		9,278		300	42,653	3,106	7.3
1915	31,666	5,899	([a])	10,854		877	65,365	5,151	7.9
1916	48,360	9,715	1,293	18,765		249	103,493	14,331	13.8
1917	115,123	13,826	6,920	32,669		181	217,884	40,189	18.4
1918	163,701	15,775	7,326	37,604	1,579		282,536	50,364	17.8
1919	189,995	20,284	9,337	52,150	5,581		351,535	64,197	18.3
1920	178,857	21,151	32,956	58,941	8,711		384,744	71,788	18.7
1921	185,341	19,856	77,141	54,646	14,558		449,934	61,815	13.7
1922	189,404	18,518	95,405	56,796	19,967		505,832	72,711	14.4
1923	270,249	19,132	177,765	63,381	21,292		816,226	77,268	9.5
	1,398,400	155,956	408,143	411,724	71,688	[b] 2,950	3,263,770	465,067	14.2
Percentage of total	42.8	4.8	12.5	12.6	2.2	0.1	100.0		

[a] Included under "Miscellaneous."
[b] Includes also Colorado for 1918.

Natural-gas gasoline produced in the United States, 1911–1923, by methods of manufacture, in thousands of gallons

Year	Compression	Oil absorption	Combination (compression and oil absorption)	Charcoal	Drip
1911	7,426				([a])
1912	12,081				([a])
1913	24,061	([a])			([a])
1914	42,653	([a])			([a])
1915	65,365	([a])			([a])
1916	84,923	18,570			([b])
1917	168,867	49,017			([b])
1918	219,767	62,769			([b])
1919	261,158	90,377	([c])		([b])
1920	281,132	103,612	([c])		([b])
1921	331,867	118,067	([c])		([b])
1922	[d] 284,475	[d] 154,702	[d] 64,738	([b])	1,917
1923	290,872	384,224	136,787	2,931	1,412

[a] Included under "Compression."
[b] Included under "Oil absorption."
[c] Included under "Compression" and "Oil absorption."
[d] Revised figures.

Natural gas produced and consumed and portion treated for extraction of natural-gas gasoline, 1911–1923

	Produced and delivered to consumers (millions of cubic feet)	Consumed (millions of cubic feet)	Treated for extraction of gasoline (millions of cubic feet)	Ratio (percentage) of natural gas treated for gasoline	
				To quantity produced and delivered to consumers	To quantity consumed
1923					
Arkansas	24,215	33,746	3,975	16	12
California [a]	131,434	131,434	211,409	161	161
Illinois	4,049	4,049	3,207	79	79
Kansas	32,072	37,637	10,843	34	29
Kentucky [b]	11,953	21,232	22,925	192	108
Louisiana	112,031	111,434	87,944	78	79
New York	6,497	16,495	640	10	4
Ohio	53,812	120,920	39,805	74	33
Oklahoma	203,082	173,788	136,563	67	79
Pennsylvania	112,562	138,478	55,238	49	40
Texas [a] [b]	74,535	[c] 83,046	113,733	153	137
West Virginia [d]	203,867	88,827	164,906	81	186
Wyoming	35,523	34,576	24,523	69	71
Others	2,503	12,473			
	1,008,135	[c]1,008,135	875,711	87	87
1911	512,993		2,476	0.5	
1912	562,203		4,688	1	
1913	581,898		9,889	2	
1914	591,867		16,895	3	
1915	628,579		24,064	4	
1916	753,170		208,705	28	
1917	795,110		429,288	54	
1918	721,001		449,109	62	
1919	745,916		480,404	64	
1920	798,210		496,431	62	
1921	662,052		465,097	70	
1922	762,546		545,139	71	

[a] Large quantities of gas both before and after the extraction of gasoline were blown in the air or unaccounted for.

[b] Quantities of natural gas were piped from other States, treated for gasoline extraction, and residue gas returned to State in which produced.

[c] Includes 9 million cubic feet consumed in Mexico.

[d] Natural gas was treated for gasoline extraction and consumed in other States.

PETROLEUM

By G. B. Richardson[1]

INTRODUCTION

All records for the output of crude petroleum in the United States were broken in 1923 by the production of 732,407,000 barrels, representing almost 72 per cent of the world's output, which for the first time exceeded 1,000,000,000 barrels. This is an increase of 31 per cent over the previous high record for the United States, attained in 1922, and may mark the peak of production for this country.

The great production of petroleum in 1923 was due to the flush output from a number of highly productive new fields in California, Arkansas, Texas, and Oklahoma, marking the culmination of the discovery during the last six years of more than a score of extraordinarily large pools, among which are the Elk Hills, Santa Fe Springs, Long Beach, and Huntington Beach, in California; the West Columbia, Hull, Ranger, Burkburnett, Mexia, and Powell, in Texas; the Hewitt, Beggs, Bristow, Burbank, and Tonkawa, in Oklahoma; the Homer and Haynesville, in Louisiana; the Eldorado-Towanda, in Kansas; and the El Dorado and Smackover, in Arkansas. There was also an increased output in the Salt Creek field, in Wyoming. The domestic production was augmented by imports of crude oil amounting to 82,015,000 barrels, which, although 45,000,000 barrels less than was imported in 1922, brought the new supply of crude petroleum for this country during the year to the record total of 814,422,000 barrels. Consumption continued to increase but did not keep pace with the new supply, and in 1923, for the first time since 1914, the sum of indicated deliveries to consumers and exports of crude oil (which amounted to 731,701,000 barrels) was less than the domestic production. As a result of the year's operations, pipe-line, tank-farm, and producers' stocks of crude petroleum increased 82,721,000 barrels and on December 31, 1923, amounted to 344,624,000 barrels, a quantity sufficient, at the average daily rate for 1923 of deliveries to domestic consumers and exports, for 172 days. This unprecedentedly large quantity of petroleum in storage did not include stocks held by consumers, of which only the stocks held at refineries are known; these on December 31, 1923, amounted to 33,000,000 barrels of crude oil, and in addition the refiners held 75,000,000 barrels of liquid refined products. This condition of oversupply was reflected in general low prices, and at the end of the year the price of Mid-Continent crude oil had declined to the low level reached during the period of postwar deflation in 1921. The average price of all grades of crude oil at the wells, $1.34 a barrel, was the lowest since 1916. Despite

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[1] The tables in this report have been prepared, unless otherwise indicated, by Misses A. B. Coons, M. N. Schellenger, A. L. Clapp, and C. M. Shanner, of the U. S. Geological Survey.

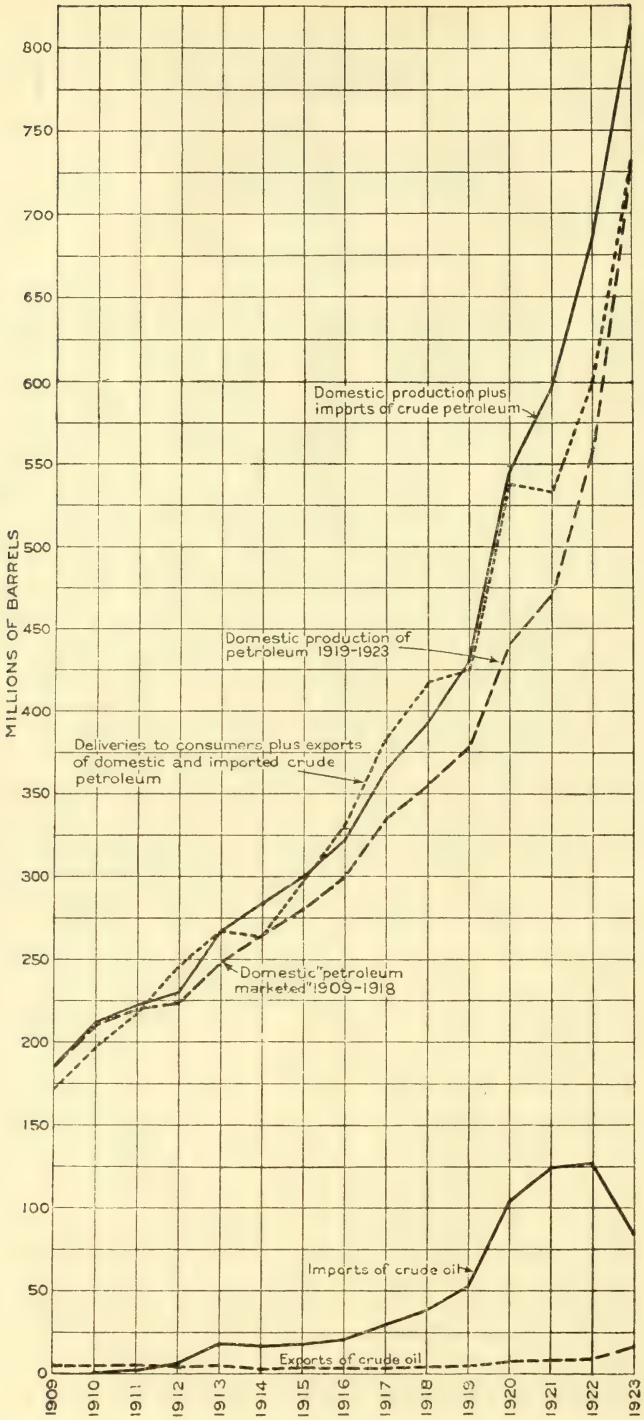

FIGURE 16.—Crude petroleum produced, imported, exported, and delivered to consumers in the United States, 1909–1923.

the overproduction, more than 24,000 wells were drilled for oil and gas during the year. On December 31, 1923, there were approximately 290,100 producing oil wells in the United States, and the average daily production per well was 6.6 barrels.

Condensed summary of statistics of crude petroleum, 1919–1923

[Thousands of barrels of 42 U. S. gallons]

	1919	1920	1921	1922	1923
Production	378, 367	442, 929	472, 183	557, 531	732, 407
Imports	52, 822	106, 175	125, 364	127, 308	82, 015
	431, 189	549, 104	597, 547	684, 839	814, 422
Indicated deliveries to domestic consumers	420, 462	530, 532	526, 032	592, 432	714, 316
Exports	6, 019	8, 757	8, 940	10, 163	17, 385
Added to stocks [a]	4, 708	9, 815	62, 575	82, 244	82, 721
	431, 189	549, 104	597, 547	684, 839	814, 422
Average price per barrel at wells	$2. 01	$3. 07	$1. 73	$1. 61	$1. 34

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[a] Pipe-line, tank-farm, and producers' stocks of domestic petroleum and stocks of foreign petroleum held in the United States by importers.

Summary of statistics of crude petroleum, 1913–1923

Monthly averages by years, 1913-1923

	Production		Imports		Stocks at beginning of period [a]		Supply		Indicated deliveries to domestic consumers		Exports		Demand		Wholesale price of all commodities [c] (index No. [b])	Price of Oklahoma-Kansas grade crude oil	
	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]		Dollars.	Index No. [b]
1913	20, 704	100	1, 415	100	122, 870	100	144, 989	100	21, 738	100	386	100	22, 124	100	100	0. 939	100
1914	22, 147	107	1, 409	100	122, 803	100	146, 359	101	21, 747	100	248	64	21, 995	99	98	. 76	81
1915	23, 425	113	1, 512	107	141, 550	115	166, 487	115	24, 231	111	314	81	24, 545	111	101	. 60	64
1916	25, 064	121	1, 733	122	194, 185	158	220, 982	152	27, 035	124	341	88	27, 376	124	127	1. 26	134
1917	27, 943	135	2, 511	177	179, 372	146	209, 826	145	31, 526	145	342	89	31, 868	144	177	1. 81	193
1918	29, 661	143	3, 145	222	159, 452	130	192, 258	133	34, 356	158	408	106	34, 764	157	194	2. 20	234
1919	31, 531	152	4, 402	311	128, 586	105	164, 519	113	35, 039	161	502	130	35, 541	161	206	2. 28	243
1920	36, 911	178	8, 848	625	136, 213	111	181, 972	126	44, 211	203	730	189	44, 941	203	226	3. 42	364
1921	39, 349	190	10, 447	738	[d]146, 028 [e]128, 187	119 104	[d] 195, 824 [e] 177, 983	135 123	43, 836	202	745	193	44, 581	202	147	1. 65	176
1922	46, 461	224	10, 609	750	190, 762	155	247, 832	171	49, 369	227	847	219	50, 216	227	149	1. 67	178
1923	61, 034	295	6, 835	483	273, 006 [f]261,903	222 213	340, 875 [f]329, 772	235 227	59, 526	274	1, 449	375	60, 975	276	154	1. 45	154

By months, 1923

	Production		Imports		Stocks at beginning of period [a]		Supply		Indicated deliveries to domestic consumers		Exports		Demand		Wholesale price of all commodities [c] (index No. [b])	Price of Oklahoma-Kansas grade crude oil	
	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]	Thousands of barrels	Index No. [b]		Dollars.	Index No. [b]
January	52, 527	254	7, 307	516	264, 578 [f]253, 475	215 206	324, 412 [f]313, 309	224 216	54, 229	249	762	197	54, 991	249	156	1. 38	147
February	48, 588	235	6, 199	438	258, 197	210	312, 984	216	51, 492	237	666	173	52, 158	236	157	1. 76	187
March	56, 969	275	8, 058	569	260, 717	212	325, 744	225	59, 696	275	1, 028	266	60, 724	274	159	1. 85	197
April	59, 008	285	6, 617	468	264, 899	216	330, 524	228	58, 740	270	1, 511	391	60, 251	272	159	1. 82	194
May	62, 377	301	5, 995	424	270, 155	220	338, 527	233	57, 811	266	1, 324	343	59, 135	267	156	1. 50	160
June	62, 845	304	5, 996	424	279, 272	227	348, 113	240	55, 145	254	2, 598	673	57, 743	261	153	1. 45	154
July	65, 925	318	6, 915	489	290, 252	236	363, 092	250	62, 057	285	1, 547	401	63, 604	287	151	1. 45	154
August	66, 422	321	7, 580	536	299, 368	244	373, 370	258	64, 608	297	1, 542	399	66, 150	299	150	1. 45	154
September	65, 306	315	6, 021	426	307, 100	250	378, 427	261	62, 224	286	1, 592	412	63, 816	288	154	1. 39	148
October	67, 506	326	6, 825	482	314, 493	256	388, 824	268	63, 600	293	1, 315	341	64, 915	293	153	1. 30	138
November	65, 388	316	6, 085	430	323, 789	264	395, 262	273	60, 860	280	1, 397	362	62, 257	281	152	1. 07	114
December	59, 546	288	8, 417	595	332, 887	271	400, 850	276	63, 854	294	2, 103	545	65, 957	298	151	1. 00	106

[a] Stocks included under "Monthly averages by years, 1913–1923," include producers', pipe-line, and tank-farm stocks of domestic petroleum and since 1919 stocks of foreign petroleum held in the United States by importers. Stocks included under "By months, 1923," include pipe-line and tank-farm stocks of domestic petroleum and stocks of foreign petroleum held in the United States by importers but do not include producers' stocks of domestic petroleum.

[b] Index numbers based on monthly average for 1913=100.

[c] Department of Labor.

[d] Stocks as reported by unrevised method comparable with preceding years.

[e] Stocks as reported by revised method. (See U. S. Geol. Survey Mineral Resources, 1921, pt. 2, p. 284, 1923.)

[f] Includes only foreign petroleum held by importers in the United States elsewhere than at refineries.

PRODUCTION

DOMESTIC PRODUCTION

RANK OF STATES

The three leading oil-producing States—California, Oklahoma, and Texas—in 1923 produced more than 75 per cent of the total output of the country. In this group California, by its output of 262 million barrels, was in a class by itself; and Oklahoma and Texas, each producing considerably more than 100 million barrels, far outranked the other States.

Wyoming, Arkansas, Kansas, and Louisiana, in the order named, constitute another group of States, in which each produces between 20 and 50 million barrels. Illinois, Kentucky, Pennsylvania, Ohio, West Virginia, Montana, New York, and Indiana, in the order named, in 1923 produced between 1 and 9 million barrels. The small producers—Colorado, Alaska, Tennessee, New Mexico, and Missouri—complete the list.

During 1923 there were several changes in rank of the oil-producing States. California took the lead from Oklahoma, which for a number of years had ranked first. Texas maintained third place, which it assumed in 1919. Wyoming advanced from sixth to fourth place, passing Louisiana and Kansas, and Arkansas advanced from seventh to fifth place, also passing Louisiana and Kansas, which in 1922 ranked, respectively, fourth and fifth. (See Pl. IV.)

CALIFORNIA

The outstanding event of the year in the petroleum industry was the remarkable production of California as the result of the development of the Santa Fe Springs, Long Beach, and Huntington Beach fields in the Los Angeles Basin. The combined output of these three fields, amounting to more than 183 million barrels, was 22 million barrels greater than the production of the whole State of Oklahoma and was more than two-thirds of California's total production of 262,876,000 barrels. This record production in California was almost double the output of that State in 1922 and was equivalent to 36 per cent of the total output of the United States in 1923. The increase of production in California was greater than the total production of the State in any one year prior to 1922. Coinciding in time with decreased production and imports of Mexican petroleum, this flood of California oil resulted in the shipment through the Panama Canal to Atlantic and Gulf coast ports in the United States of about 53 million barrels of crude oil having an average gravity of approximately 30° A. P. I. (0.8762), besides which some 4 million barrels of California oil was exported to Mexico.

In order to reduce the oversupply as far as possible, many wells in the older fields in California were closed in. The State Mining Bureau estimates that in October the capacity of the closed-in wells amounted to more than 107,000 barrels a day. This policy resulted in a decrease of more than 11 million barrels in the output of Fresno and Kern counties as compared with the production from those counties in 1922.

Huntington Beach was the first of the three large pools of the Los Angeles Basin to produce on a commercial basis. Gas showings and the recognition of a possible relation of topography to structure called attention to this area, and the first well was completed for production in August, 1920. The top of the oil-producing formation lies at a depth of about 1,914 feet. Development has shown the existence of two oil zones separated by a water-bearing bed about 80 feet thick. The upper zone is 600 to 800 feet thick, and the oil produced from it is obtained mostly from rather loose sands, separated by thin layers of sandy shale. The gravity of the oil from this zone ranges from 17° to 25° (0.953 to 0.904). The lower zone is possibly 2,000 feet thick and yields oil from much more shaly material than the upper zone. The gravity of the oil from the lower zone is from 24° to 28° (0.910 to 0.887). The average daily production of the discovery well in the Huntington Beach field during the first month was about 85 barrels. By January, 1921, three wells were producing at a daily average of 328 barrels of oil per well. In January, 1922, 66 wells produced at a daily average of 245 barrels per well, and in January, 1923, 159 wells produced at a daily average of 505 barrels per well.[2] To January 1, 1924, the Huntington Beach pool had produced 47,554,000 barrels of petroleum.

In the Santa Fe Springs field the possibilities of oil accumulation were suggested by the slightly elevated country and by the presence of gas in water wells. No surface dips are exposed, but development has shown the field to be a closed anticline whose axis trends northwest. In 1907 and 1908 the Union Oil Co. of California drilled two wildcat wells, Myer Nos. 1 and 2, in which gas was encountered but no oil. In October, 1919, Myer No. 3 came in at a depth of 4,595 feet, flowing at a rate of about 3,000 barrels of oil a day, but water broke in and stopped production, and when the well was brought in again the yield was only about 150 barrels a day. The field attracted little attention until November, 1921, when Bell No. 1, 1½ miles northwest of Myer No. 3, was brought in at a depth of 3,788 feet and flowed 2,000 barrels a day of 31° (0.871) oil. This well was the cause of great excitement and led to intensive "town-lot development." Royalties paid to landowners are reported to have ranged from 16⅔ to 50 per cent, and usually cash bonuses were paid in addition. It is said that for one 19-acre tract a bonus of $410,000 and a 50 per cent royalty were paid. In December, 1922, there were 70 producing wells and 166 wells being drilled, and on September 10, 1923, there were 211 producing wells and 191 wells being drilled. Part of the producing area was divided into town lots, and elsewhere the oil land was held in fairly large tracts. In the town-lot area there was congested drilling. In one 40-acre tract, for instance, there were 60 wells, whereas normally in a deep high-pressure field one well to 8 or 10 acres would be considered appropriate. The surface formations in the Santa Fe Springs field consist of sticky clay and loose, unconsolidated sandy shale, sand, and gravel. Underlying these deposits is a thick shale bed which serves as a cap for a high-pressure gas zone. This gas zone is encountered at depths ranging from 2,000 to 2,100 feet and consists of sandy shale, sand, and shale with streaks of sand. The gas zone is probably about 1,500 feet thick and extends down nearly to the top of the first oil zone. Beneath the gas zone are three

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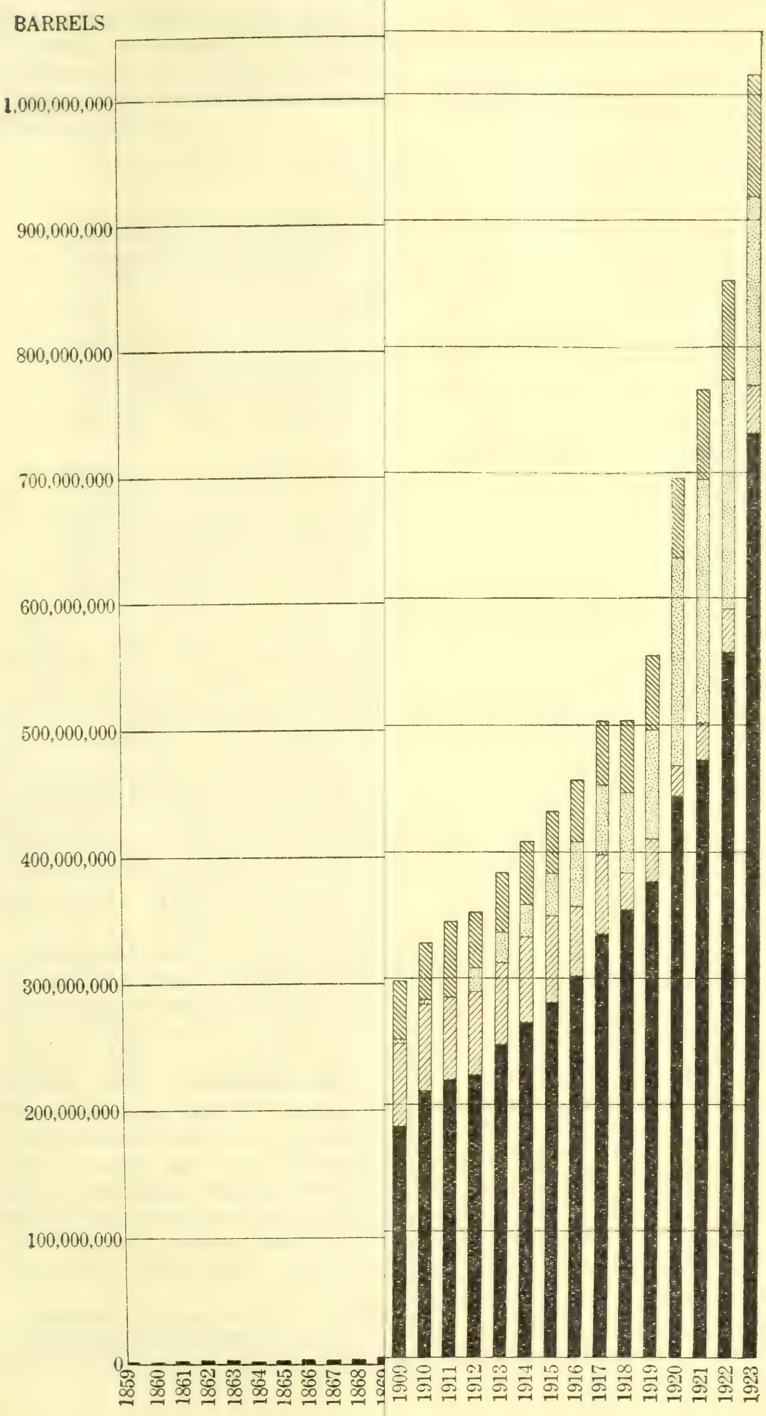
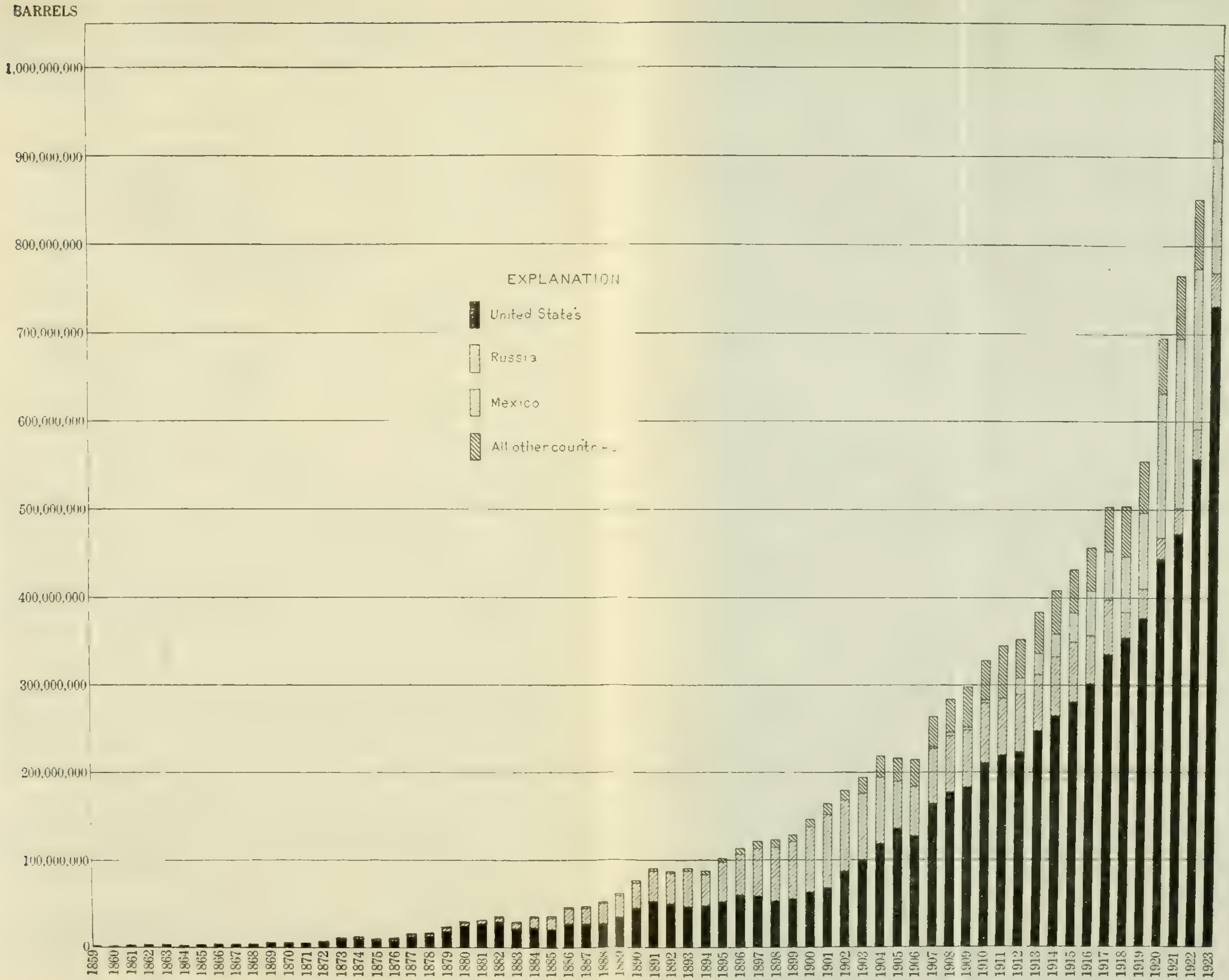
[1] Gester, S. H., Am. Assoc. Petroleum Geologists Bull., vol. 8, p. 42, 1924.



PRODUCTION OF NTRIES, 1859–1923



PRODUCTION OF PETROLEUM IN THE UNITED STATES, RUSSIA, MEXICO, AND ALL OTHER COUNTRIES, 1859–1923 oil-bearing zones known as the Foix, Bell, and Meyer zones. These oil zones are separated by shale.[3] To January 1, 1924, the Santa Fe Springs oil field had produced 92,312,000 barrels. The following statement is quoted from a report published by the California State Mining Bureau:[4]

Wells and production in Santa Fe Springs field, May 31, 1923

Daily average production..................barrels..	235,755
Number of wells producing........................	112
Average daily production per well..........barrels..	2,105
Number of wells flowing..........................	103
Number of wells being pumped.....................	9
Daily production from Bell zone............barrels..	23,190
Number of wells producing from Bell zone..........	41
Average daily production per well from Bell zone..barrels..	565
Daily production from Meyer zone..............do....	212,545
Number of wells producing from Meyer zone.........	71
Average daily production per well from Meyer zone ....barrels..	2,993
Number of wells being drilled.....................	247
Number of wells idle..............................	26
Number of wells being drilled below a depth of 4,000 feet..	133
Rigs being built and completed....................	80
Average initial production of new wells in May..barrels..	3,813
Number of concerns producing......................	38
Proved area Mar. 1, 1923....................acres..	1,995

The Long Beach oil field is in the city of Long Beach, in the southern part of the Los Angeles Basin, and occupies an elevated area known as Signal Hill. Structurally the producing area is a closed anticline, approximately 3½ miles long and one-half to three-quarters of a mile wide. The existence of the anticline at Signal Hill has long been known from the dips of outcropping beds, but it was not tested until 1916–17, when a well was sunk to a depth of 3,449 feet without finding oil. Development has shown that this well was located a short distance outside of the present producing area. The discovery well of the field, Alamitos No. 1, was brought in by the Shell Co. in June, 1921. This well was completed at a depth of 3,114 feet and gave an initial production of 500 barrels of 21° (0.928) oil. The discovery caused great activity, which was stimulated by the owners of the town-lot subdivisions, and the development of the field was very rapid. Six months after discovery, at the end of 1921, there were 38 operators, 75 active rigs, and 8 producing wells. At the end of 1922 there were 158 operators, 395 active rigs, and 148 producing wells, and at the end of August, 1923, 26 months after discovery, there were 222 operators, 700 active rigs, and 270 producing wells.[5] Up to January 1, 1924, the Long Beach field had produced 86,032,000 barrels. In November, 1923, one gas zone and three oil zones were recognized in this field. Gas under high pressure was found at depths of 1,400 to 1,800 feet. Below the gas zone three oil zones have been encountered, known as the Wilbur, Alamitos, and Brown zones. The gravity of the oil from the Long Beach field ranges from 18° to 31° (0.947 to 0.871).

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[3] Templeton, R. R., and McCollom, C. R., Am. Assoc. Petroleum Geologists Bull., vol. 8, p. 179, 1924.

[4] Case, J. B., Santa Fe Springs oil field: California Oil Fields, May, 1923, p. 19, California State Min. Bur.

[5] Schwennesen, A. T., Overbeck, R. M., and Dubendorf, H. H., The Long Beach oil field and its problems: Am. Assoc. Petroleum Geologists Bull., vol. 8, p. 418, 1924.

The following statement is taken from a report by the State Mining Bureau:[6]

Wells and production in Long Beach field, November 1, 1923

Daily average production	barrels	255,000
Number of wells producing		272
Average daily production per well	barrels	937
Number of wells flowing		212
Number of wells being pumped		60
Number of wells being drilled (active)		209
Number of wells being drilled (idle)		104
Number of producing wells (idle)		28
Depth of deepest well in the field	feet	5,972
Proved area Nov. 1, 1923	acres	1,120
Recovery per acre to Nov. 1, 1923 (approximate)	barrels	64,285

OKLAHOMA

Oklahoma's production of 160,929,000 barrels was an increase of more than 7 per cent over its previous record output of 149,571,000 barrels in 1922. Prior to 1922 the greatest output for the State was in 1915, at the height of the development of the Cushing pool. The official figures of "marketed production" of petroleum in Oklahoma for the years 1914 to 1918 do not indicate the quantity of petroleum taken from the ground during those years, because they do not take into account the many million barrels produced during the period of flush output of the Cushing field but held in storage by producers and not delivered to marketing companies. The figures of "marketed production" fall far short of the actual production for 1914 and 1915 and show more than the actual production for the years immediately following, during which the oil put in storage in the period of flush production was marketed.

The large production in Oklahoma in 1923 was caused chiefly by gains in the Tonkawa and Burbank districts. The output of the older pools, though still large, is declining.

Gardner[7] reports that 34 wells were drilled in Oklahoma in 1923 that opened new pools or discovered new producing sands at greater depths or were important gas wells that appear to be markers for new oil pools. Gardner reports that one of the largest wells ever drilled in Oklahoma, if not the largest, was that of the Southwestern Petroleum Co. and the Carter Oil Co. in sec. 21, T. 4 S., R. 2 W., in the Hewitt field, which on May 30, 1923, flowed 14,460 barrels from a depth of 2,940 feet.

TEXAS

The production of 131,023,000 barrels of petroleum in Texas in 1923, an increase of 10 per cent over the output of the State in 1922, marks the fifth successive year of large annual increases by which the State has progressed from an annual output of less than 40,000,000 barrels in 1918 and preceding years (Pl. IV).

The production of the Gulf coast fields of Texas, in which are included only the proved or probable salt-dome pools. decreased from

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[6] Case, J. B., and Keyes, R. L., Report on the Long Beach oil field: California Oil Fields, October, 1923, p. 17, California State Min. Bur.

[7] Gardner, J. H., Oil development in Oklahoma in 1923: Mines and Metallurgy, April, 1924, p. 74.

35,370,000 barrels in 1922 to 30,821,000 barrels in 1923, but the output in the remainder of the State increased from 83,314,000 to 100,202,000 barrels.

The outstanding event of the year in connection with the production of petroleum in Texas was the discovery of the Powell pool. After the development of the Mexia pool, in Limestone County, in 1921 and 1922 and the proof of its location along a fault line, there was much activity in prospecting along the supposed continuation of the Mexia fault in a belt roughly parallel to the Balcones fault zone and between 20 and 30 miles southeast of it. The Powell pool, in Navarro County, and the Currie, Minerva, and Luling pools were thus discovered.

The first well in the Powell pool was completed on January 7, 1923, and by the end of the year there were more than 500 completed wells in the pool, with an average initial daily production of 2,500 barrels per well and an estimated total production for the year of approximately 30,500,000 barrels—an unprecedented record for a pool in the first 12 months of its development. The oil in the Powell field is obtained from 40 to 60 feet of pay sand at a depth of 2,900 to 3,000 feet.[8]

The output of the Mexia pool during 1923 declined from a daily average of approximately 56,000 barrels in January to 38,000 barrels in December. The maximum output from the pool (approximately 150,000 barrels a day) was attained in January, 1922.

The Luling pool, opened in 1922, was actively developed in 1923 and produced about 1,000,000 barrels. The pool is terminated on its western border by a fault some 30 miles southeast of the Balcones fault zone, and the oil is obtained from a dolomitic phase of an Upper Cretaceous limestone at a depth of about 2,300 feet. Several other new or relatively new pools in north-central and western Texas were developed in 1923, including the Freeman, Hampton, Panther, Sunshine, and Swastika pools, in Archer County; the Westbrook pool, in Mitchell County; the Carson County pool, in the Amarillo district; and the Big Lake pool, in Reagan County.

Although production in the Texas Gulf coast fields as a whole decreased 4½ million barrels in 1923, the output of some of the older pools was increased either by extension of the producing area or by deeper drilling, and some promising new areas were opened up. The most noteworthy decline was the falling off in production of the West Columbia pool from 11,126,000 barrels in 1922 to 5,994,000 barrels in 1923, because of which West Columbia lost its rank as the leading producer among the Gulf coast pools. The Hull pool increased its production by 754,000 barrels and thereby took first place. Goose Creek is credited with a gain of 1,260,000 barrels.

WYOMING AND OTHER ROCKY MOUNTAIN STATES

The production of petroleum in Wyoming increased from 26,715,000 barrels in 1922 to 44,785,000 barrels in 1923, a gain of 68 per cent. This gain was due chiefly to the intensive development of the Salt Creek pool, the increased yield of which was made in spite of proration of pipe-line runs, which was effective for practically the entire year. The output of the Teapot field also increased from 37,000 barrels produced during the last four months of 1922 to 1,156,000 barrels in 1923. Smaller gains are reported in the Big Muddy, Hamilton Dome, Lance Creek, and Lost Soldier pools. Decreased output is reported for the other Wyoming fields. Five new oil fields were discovered in Wyoming during 1923—Rex Lake, Medicine Bow, Simpson Ridge, Notches, and Black Mountain.[9]

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[8] Fohs, F. J., Production of petroleum in 1923, p. 82, Am. Inst. Min. Met. Eng., 1924.

During 1923 progress was made on the construction of the trunk pipe line from the Salt Creek and Teapot fields, Wyoming, across Nebraska and Kansas to Freeman, Mo., a distance of more than 700 miles. The line was completed early in 1924, and the first runs were reported in April. By this means crude petroleum from Wyoming was brought for the first time into direct competition with oil from the Mid-Continent fields.

Montana's production of 2,782,000 barrels in 1923 represents a gain of 333,000 barrels over the output of 1922. A slight decrease in the yield of the Cat Creek pool, which apparently attained its peak in 1922, was offset by 523,000 barrels produced in the Kevin-Sunburst field.

Lack of transportation facilities prevented noteworthy development of the Soap Creek and Devils Basin pools. Prospecting on the Big Lake anticline in an area that had been recommended by the Geological Survey in 1922 as favorable for testing led to the discovery of the Lake Basin pool in 1924.

In Colorado production of petroleum in 1923 continued the decline which has been recorded for that State for many years. Its output of 86,000 barrels, coming from the Florence and Rangely pools with an insignificant amount from the Boulder pool, was the smallest credited to Colorado since the beginning of the record in 1887. However, drilling during 1923 in Moffat and Larimer counties led to developments in 1924 that have materially changed the outlook for oil in that State. In August, 1923, petroleum was found in beds of Upper Cretaceous shale at a depth of about 2,000 feet on the Hamilton dome, about 13 miles south of Craig, Moffat County. The oil is of high grade, having a gravity of approximately 41° (0.820), and developments in 1924 resulted in the marketing of more oil from this field, known as the Moffat pool, than has been produced in Colorado for a number of years. The bringing in of a large gas well on the Wellington anticline, near Fort Collins, in 1923, with which some oil is associated, suggests that other folds in northeastern Colorado will be productive of oil and gas.

New Mexico for a number of years has produced a practically negligible quantity of oil from the vicinity of Dayton, in Eddy County, in the southeast corner of the State. In 1923, however, oil of exceptionally high grade (gravity 56°, or 0.755) was discovered in paying quantity on the Hogback anticline, in San Juan County, in the northwest corner of the State. None of this oil was marketed during 1923 on account of the distance from a railroad.

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[9] Fisher, C. A., Production of petroleum in 1923, p. 52, Am. Inst. Min. Met. Eng., 1924.

ARKANSAS

Arkansas is credited with a production of 36,610,000 barrels of petroleum in 1923, nearly three times the output of the State in 1922. The Smackover pool, which during parts of June and July, 1923, produced more than 120,000 barrels a day (increased to 150,000 barrels in May, 1924), has become one of the largest producers in the United States. An output of 30,048,000 barrels from this pool in 1923 was reported to the Geological Survey. This is less than the actual production because a number of small operators failed to report and because, on account of the rapid expansion of the pool and the inadequate facilities for storing and marketing the flood of oil produced during the early stages of development, considerable oil was lost. The Smackover field is divided into an eastern and a western part, which are separated by a barren strip. The greater part of the output of the Smackover pool is a heavy oil, averaging approximately 20° (0.934) and comes from the eastern part of the field; the western part produces an oil of lighter grade, ranging between 24° and 29° (0.910–0.882). A number of wells of unusually large initial production are reported in the Smackover field. The Burton gusher, in the western part of the field, is said to have produced, initially at least, 30,000 barrels a day.[10]

The El Dorado pool, which was discovered in 1921 and produced more than 10 million barrels in that year and also in 1922, is credited with an output of only 5,830,000 barrels in 1923.

A new pool near Irma, in Nevada County, was opened in September, 1922, and developed during 1923, although for lack of transportation facilities no oil was shipped until 1924. The product is a heavy oil, ranging between 13° and 15° (0.979–0.966), and is reported to occur in a well-developed "nose" terminated on the north by a fault.[11] The Stephens pool, opened in 1922, was further developed, and the Stephens and Irma pools are credited with a combined production of 732,000 barrels.

Considerable "wildcatting" was done in southern Arkansas during 1923, but no new pools were proved.

KANSAS

The production of petroleum in Kansas in 1923, amounting to 28,250,000 barrels, was 3½ million barrels less than the output of 1922. This is the third successive year of declining production in Kansas. Drilling in 1923, however, was the forerunner of the development in 1924 of the Rainbow Bend pool, in Cowley County, the output of which has tended to check the decline. The discovery of oil in sec. 8, T. 12 S., R. 15 W., in Russell County, opened up new territory many miles from any known pool.

LOUISIANA

Louisiana produced 24,919,000 barrels of petroleum in 1923, as contrasted with 35,376,000 barrels in 1922. A gain of 703,000 barrels is reported in the Gulf coast field, but it was offset by a loss of more than 11 million barrels in the northern part of the State, due to sharp declines in the Haynesville and Homer pools and to smaller losses in the older pools. Bellevue, however, in 1923, the second year of its development, increased its output by more than a million barrels.

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[10] Wilson, M. E., Production of petroleum in 1923, p. 100, Am. Inst. Min. Met. Eng., 1924.
[11] Wilson, M. E., op. cit.

EASTERN STATES

Continued decreased production in Illinois, Indiana, Kentucky, Tennessee, and West Virginia and slight gains in Ohio, New York, and Pennsylvania are recorded for 1923. The slight gains are due not so much to the bringing in of new pools or to the discovery of deeper sands in the old pools as to improved methods of recovery. In the Bradford field, in New York and Pennsylvania, for instance, increased production has been attained by the successful application of flooding, which has been practiced for several years. The results of flooding in this field indicate that the yield may be double that obtained prior to flooding. Conditions especially favorable to flooding exist in the Bradford field—considerable thickness and relative uniformity of texture and porosity of the oil-saturated sands over a large area. Examination by A. F. Melcher of a number of cores that have recently been sent to the U. S. Geological Survey shows that the pay sand, which is approximately 35 feet thick, is not quite so homogeneous as had been supposed but rather is streaked with irregular thin bands of shale. The porosity of the pay sand as determined by Mr. Melcher averages possibly 17 per cent. A preliminary result of his study is to show that development prior to flooding recovers only about 10 or 15 per cent of the original oil content of the sand and that after flooding approximately 25 to 30 per cent of the original oil content of the sand is recovered.

STATISTICS

The statistics of petroleum published by the Geological Survey are compiled from reports made to the Survey by producing, purchasing, and marketing companies. The results are made public in a monthly press bulletin and in an annual report.

For the States east of California figures of production are compiled from monthly reports of companies that operate gathering lines, which show the quantity of petroleum transported from producing properties. Petroleum consumed on the leases and produced but not transported from the producing property is not included in the preliminary monthly figures of production, which account for approximately 99 per cent of the total output of petroleum; but these items, among others, are obtained from the annual canvass of producers and are included in the Survey's final figures of production, which are intended to show all oil taken from the ground. For California the preliminary figures published in the Survey's monthly press bulletin are those of the American Petroleum Institute, and the final figures published in the annual report are those compiled, from sworn reports of producers, by the California State Mining Bureau.

The degree of detail in which the Geological Survey can present statistics of production is determined by the data supplied by pipeline companies. Detailed figures by months showing petroleum transported from producing properties can be compiled for isolated pools like those of the Gulf coast field and of northern Louisiana and Wyoming, the records of which are kept separately on the books of the companies. But in States like Oklahoma and Pennsylvania, where the pools are close together and where different pipe-line companies have different boundaries delimiting their field districts, it is not practicable for the Survey to obtain data of production by pools.

The canvass of producers of petroleum for the year 1923 resulted in replies from 6,320 companies. An analysis of the returns shows that 61 per cent of the total output of petroleum in the United States in 1923 was produced by approximately 1 per cent of the operators, and that 51 per cent was produced by 30 individual companies and 53 per cent by 20 companies, including their subsidiaries. No individual company, however, produced as much as 4 per cent of the total output of the country, and no company, including its subsidiaries, produced as much as 7 per cent of the total. The several companies and their subsidiaries constituting the so-called "Standard" group produced 21 per cent of the total. The quantity of oil produced from public lands under the leasing act, not including production on Indian reservations, amounted to 6½ per cent of the total.

Petroleum produced in the

[Thousands of barrels

Year	New York	Pennsylvania	West Virginia	Kentucky	Tennessee	Ohio	Indiana	Illinois	Kansas
1859–1875	(b)	[b] 74, 072	--------	--------	--------	--------	--------	--------	--------
1876	(b)	[b] 8, 969	120	--------	--------	32	--------	--------	--------
1877	(b)	[b] 13, 135	172	--------	--------	30	--------	--------	--------
1878	(b)	[b] 15, 164	180	--------	--------	38	--------	--------	--------
1879	(b)	[b] 19, 685	180	--------	--------	29	--------	--------	--------
1880	(b)	[b] 26, 028	179	--------	--------	39	--------	--------	--------
1881	(b)	[b] 27, 376	151	--------	--------	34	--------	--------	--------
1882	6, 685	23, 368	128	--------	--------	40	--------	--------	--------
1883	4, 004	19, 125	126	[c] 5	(c)	47	--------	--------	--------
1884	3, 231	20, 541	90	[c] 4	(c)	90	--------	--------	--------
1885	2, 658	18, 118	91	[c] 5	(c)	662	--------	--------	--------
1886	2, 151	23, 647	102	[c] 5	(c)	1, 783	--------	--------	--------
1887	2, 075	20, 281	145	[c] 5	(c)	5, 023	--------	--------	--------
1888	(b)	[b] 16, 489	119	[c] 5	(c)	10, 011	--------	--------	--------
1889	1, 897	19, 591	544	[c] 5	(c)	12, 472	33	1. 5	0. 5
1890	(b)	[b] 28, 458	493	[c] 6	(c)	16, 125	64	1	1
1891	1, 585	31, 424	2, 406	[c] 9	(c)	17, 740	137	. 5	1. 5
1892	1, 273	27, 149	3, 810	[c] 7	(c)	16, 363	698	1	5
1893	1, 032	19, 283	8, 446	[c] 3	(c)	16, 249	2, 335	1	18
1894	942	18, 078	8, 577	[c] 2	(c)	16, 792	3, 689	(d)	40
1895	913	18, 231	8, 120	[c] 2	(c)	19, 545	4, 386	(d)	44
1896	1, 205	19, 379	10, 020	[c] 2	(c)	23, 941	4, 681	(d)	114
1897	1, 279	17, 983	13, 090	(d)	(c)	21, 561	4, 122	1	81
1898	1, 205	14, 743	13, 615	[c] 6	(c)	18, 739	3, 731	(d)	72
1899	1, 321	13, 054	13, 911	[c] 18	(c)	21, 142	3, 848	(d)	70
1900	1, 301	13, 258	16, 196	[c] 62	(c)	22, 363	4, 874	(d)	75
1901	1, 207	12, 625	14, 177	[c] 137	(c)	21, 648	5, 757	(d)	179
1902	1, 120	12, 064	13, 513	[c] 185	(c)	21, 014	7, 481	(d)	332
1903	1, 163	11, 355	12, 900	[c] 554	(c)	20, 480	9, 186	--------	932
1904	1, 113	11, 126	12, 645	[c] 998	(c)	18, 877	11, 339	--------	4, 251
1905	1, 118	10, 437	11, 578	[c] 1,217	(c)	16, 347	10, 964	181	[e] 12,014
1906	1, 243	10, 257	10, 121	[c] 1,214	(c)	14, 788	7, 674	4, 397	[e] 21,718
1907	1, 212	10, 000	9, 095	[c] 821	(c)	12, 207	5, 128	24, 282	2, 410
1908	1, 160	9, 424	9, 523	728	--------	10, 859	3, 283	33, 686	1, 801
1909	1, 135	9, 299	10, 745	639	--------	10, 633	2, 296	30, 898	1, 264
1910	1, 054	8, 795	11, 753	469	--------	9, 916	2, 160	33, 143	1, 128
1911	953	8, 248	9, 796	472	--------	8, 817	1, 695	31, 317	1, 279
1912	874	7, 838	12, 129	484	--------	8, 969	970	28, 602	1, 593
1913	948	7, 917	11, 567	525	--------	8, 781	956	23, 894	2, 375
1914	939	8, 170	9, 680	503	--------	8, 536	1, 336	21, 920	3, 104
1915	888	7, 838	9, 265	437	--------	7, 825	876	19, 042	2, 823
1916	874	7, 593	8, 731	1, 202	1	7, 744	769	17, 714	8, 738
1917	880	7, 733	8, 379	3, 088	12	7, 751	760	15, 777	36, 536
1918	809	7, 408	7, 867	4, 368	8	7, 285	878	13, 366	45, 451
1919	851	8, 137	8, 327	9, 278	15	7, 736	972	11, 960	33, 048
1920	906	7, 438	8, 249	8, 738	14	7, 400	945	10, 774	39, 005
1921	988	7, 418	7, 822	9, 013	12	7, 335	1, 158	10, 043	36, 456
1922	1, 000	7, 425	7, 021	8, 973. 2	9. 8	6, 781	1, 087	9, 383	31, 766
1923	1, 250	7, 609	6, 358	8, 069	8	7, 085	1, 043	8, 707	28, 250
	[f] 58,442	[f] 772,783	332, 252	62, 263. 2	79. 8	499, 704	111, 311	349, 092	316, 975
Percentage of total production	0. 8	10. 7	4. 6	0. 9	--------	7. 0	1. 6	4. 9	4. 4

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[a] 1889–1899, Missouri; 1900–1906, Michigan and Missouri; 1907–1911, Michigan, Missouri, and Utah; 1912, 1917, 1918, Alaska and Michigan; 1913 and 1919, Alaska, Michigan, Missouri, and New Mexico; 1914–1916, Alaska, Michigan, and Missouri; 1920, Alaska, Arkansas, Missouri, New Mexico, and Utah; 1921–1923, Alaska, Missouri, and New Mexico.

[b] New York included with Pennsylvania.

United States, 1859–1923

of 42 U. S. gallons]

Oklahoma	Arkansas	Louisiana	Texas	Montana	Wyoming	Colorado	California	Other[a]	United States	Value at wells	
										Total (thousands of dollars)	Average per barrel
--------	--------	--------	--------	--------	--------	--------	--------	--------	74,072	215,781	$2.91
--------	--------	--------	--------	--------	--------	--------	12	--------	9,133	22,983	2.52
--------	--------	--------	--------	--------	--------	--------	13	--------	13,350	31,789	2.38
--------	--------	--------	--------	--------	--------	--------	15	--------	15,397	18,045	1.17
--------	--------	--------	--------	--------	--------	--------	20	--------	19,914	17,211	.86
--------	--------	--------	--------	--------	--------	--------	40	--------	26,286	24,601	.94
--------	--------	--------	--------	--------	--------	--------	100	--------	27,661	25,448	.92
--------	--------	--------	--------	--------	--------	--------	129	--------	30,350	23,631	.78
--------	--------	--------	--------	--------	--------	--------	143	--------	23,450	25,790	1.10
--------	--------	--------	--------	--------	--------	--------	262	--------	24,218	20,596	.85
--------	--------	--------	--------	--------	--------	--------	325	--------	21,859	19,198	.88
--------	--------	--------	--------	--------	--------	--------	377	--------	28,065	19,996	.71
--------	--------	--------	--------	--------	--------	76	678	--------	28,283	18,877	.67
--------	--------	--------	--------	--------	--------	298	690	--------	27,612	17,948	.65
--------	--------	--------	(d)	--------	--------	317	303	(a d)	35,164	26,963	.77
--------	--------	--------	(d)	--------	--------	369	307	(a d)	45,824	35,365	.77
(d)	--------	--------	(d)	--------	--------	666	324	(a d)	54,293	30,527	.56
(d)	--------	--------	(d)	--------	--------	824	385	(a d)	50,515	25,907	.51
(d)	--------	--------	(d)	--------	--------	594	470	(a d)	48,431	28,950	.60
(d)	--------	--------	(d)	--------	2	516	706	(a d)	49,344	35,522	.72
(d)	--------	--------	(d)	--------	4	438	1,209	(a d)	52,892	57,632	1.09
(d)	--------	--------	1	--------	3	361	1,253	(a d)	60,960	58,519	.96
1	--------	--------	66	--------	4	385	1,903	(a d)	60,476	40,874	.68
--------	--------	--------	546	--------	6	444	2,257	(a d)	55,364	44,193	.80
--------	--------	--------	669	--------	6	390	2,642	(a d)	57,071	64,604	1.13
6	--------	--------	836	--------	6	317	4,325	2	63,621	75,989	1.19
10	--------	--------	4,394	--------	5	461	8,787	2	69,389	66,417	.96
37	--------	549	18,084	--------	6	397	13,984	1	88,767	71,179	.80
139	--------	918	17,956	--------	9	484	24,382	3	100,461	94,694	.94
1,367	--------	2,959	22,241	--------	12	501	29,649	3	117,081	101,175	.86
(e)	--------	8,910	28,136	--------	8	376	33,428	3	134,717	84,157	.62
(e)	--------	9,077	12,568	--------	7	328	33,099	3	126,494	92,445	.73
43,524	--------	5,000	12,323	--------	9	332	39,748	4	166,095	120,107	.72
45,799	--------	5,789	11,207	--------	18	380	44,855	15	178,527	129,079	.72
47,859	--------	3,060	9,534	--------	20	311	55,472	6	183,171	128,329	.70
52,029	--------	6,841	8,899	--------	115	240	73,011	4	209,557	127,900	.61
56,069	--------	10,721	9,526	--------	187	227	81,134	8	220,449	134,045	.61
51,427	--------	9,263	11,735	--------	1,572	206	87,269	4	222,935	164,213	.74
63,579	--------	12,499	15,010	--------	2,407	189	97,788	11	248,446	237,121	.95
73,632	--------	14,309	20,068	--------	3,560	223	99,775	8	265,763	214,125	.81
97,915	--------	18,192	24,943	--------	4,246	208	86,592	14	281,104	179,463	.64
107,072	--------	15,248	27,645	45	6,234	197	90,952	8	300,767	330,900	1.10
107,508	--------	11,392	32,413	100	8,978	121	93,878	10	335,316	522,635	1.56
103,347	--------	16,043	38,750	69	12,596	143	97,532	8	355,928	703,944	1.98
86,911	--------	17,188	79,366	90	13,172	121	101,183	12	378,367	760,266	2.01
106,206	--------	35,714	96,868	340	16,831	111	103,377	13	442,929	1,360,745	3.07
114,634	10,473	27,103	106,166	1,509	19,333	108	112,600	12	472,183	814,745	1.73
149,571	12,712	35,376	118,684	2,449	26,715	97	138,468	13	557,531	895,111	1.61
160,929	36,610	24,919	131,023	2,782	44,785	86	262,876	18	732,407	978,430	1.34
1,469,571	59,795	291,070	859,657	7,384	160,856	11,842	1,828,727	185	7,191,989	9,338,164	------
20.4	0.8	4.0	12.0	0.1	2.2	0.2	25.4	--------	100.0	----------	------

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[a] Tennessee included with Kentucky.

[d] Less than 500 barrels. See Mineral Resources, 1916, pt. 2, pp. 684–685.

[e] Oklahoma included with Kansas.

[f] Early production in New York included with Pennsylvania.

Petroleum produced in the United States, 1922–1923, by fields

[Thousands of barrels of 42 U. S. gallons]

Field	January	February	March	April	May	June	July	August	September	October	November	December	The year	Value at wells	
														Total (thousands of dollars)	Average per barrel
1922															
Appalachian	2, 232	2, 267	2, 548	2, 386	2, 527	2, 596	2, 441	2, 566	2, 421	2, 491	2, 371	2, 334	29, 180	80, 448	$2. 76
Lima-Indiana	164	172	198	183	204	206	197	202	189	199	179	176	2, 269	5, 063	2. 23
Illinois and southwestern Indiana	996	779	945	746	909	864	844	887	823	844	801	793	10, 231	21, 018	2. 05
Mid-Continent	25, 521	24, 516	28, 231	26, 524	26, 711	26, 298	26, 690	26, 085	24, 727	25, 360	24, 651	25, 678	310, 992	532, 738	1. 71
Gulf coast	3, 274	2, 923	2, 982	2, 996	3, 151	3, 000	2, 978	3, 110	3, 047	3, 295	3, 152	3, 209	37, 117	44, 313	1. 19
Rocky Mountain	1, 839	1, 657	2, 074	2, 210	2, 483	2, 519	2, 492	2, 461	2, 497	2, 916	2, 957	3, 156	29, 261	38, 117	1. 30
California	9, 669	8, 999	10, 209	10, 121	11, 016	10, 603	11, 491	11, 747	12, 100	13, 304	13, 915	15, 294	138, 468	173, 381	1. 25
Other	1	1	1	1	1	1	1	1	1	1	1	2	13	33	2. 54
	43, 696	41, 314	47, 188	45, 167	47, 002	46, 087	47, 134	47, 059	45, 805	48, 410	48, 027	50, 642	557, 531	895, 111	1. 61
1923															
Appalachian	2, 407	2, 064	2, 428	2, 366	2, 493	2, 403	2, 325	2, 474	2, 321	2, 485	2, 208	2, 251	28, 225	78, 886	2. 79
Lima-Indiana	194	157	206	196	212	215	210	213	206	217	189	189	2, 404	4, 820	2. 00
Illinois and southwestern Indiana	844	703	871	731	857	809	813	817	759	797	755	744	9, 500	17, 690	1. 86
Mid-Continent	26, 257	23, 686	27, 832	28, 760	30, 672	30, 252	29, 997	29, 090	29, 033	32, 408	32, 882	27, 591	348, 460	535, 060	1. 54
Gulf coast	3, 260	2, 662	2, 785	2, 682	2, 871	2, 844	2, 891	2, 941	2, 750	2, 680	2, 452	2, 453	33, 271	46, 120	1. 39
Rocky Mountain	3, 202	2, 988	3, 360	3, 702	3, 861	3, 793	4, 455	4, 468	4, 492	4, 371	4, 517	4, 444	47, 653	53, 082	1. 11
California	16, 362	16, 327	19, 485	20, 570	21, 409	22, 528	25, 232	26, 417	25, 744	24, 546	22, 384	21, 872	262, 876	242, 731	. 92
Other	1	1	2	1	2	1	2	2	1	2	1	2	18	41	2. 28
	52, 527	48, 588	56, 969	59, 008	62, 377	62, 845	65, 925	66, 422	65, 306	67, 506	65, 388	59, 546	732, 407	978, 430	1. 34

Petroleum produced in the United States, 1922–1923, by States

[Thousands of barrels of 42 U. S. gallons]

State	January	February	March	April	May	June	July	August	September	October	November	December	The year	Value at wells (thousands of dollars)
1922														
Arkansas	1,152	1,032	1,087	1,135	1,108	994	973	881	739	907	1,071	1,633	12,712	20,416
California [a]	9,669	8,999	10,209	10,121	11,016	10,603	11,491	11,747	12,100	13,304	13,915	15,294	[a]138,468	[a]173,381
Colorado	7.5	7.4	7.6	7.8	9	9.6	7.6	8.2	8.5	8.7	7.6	7.5	97	114
Illinois	926	716	880	678	832	792	770	811	753	770	729	726	9,383	19,291
Indiana:														
Southwestern	70	63	65	68	77	72	74	76	70	74	72	67	848	1,727
Northeastern	18	18	21	18	22	24	21	21	19	21	18	18	239	498
Total Indiana	88	81	86	86	99	96	95	97	89	95	90	85	1,087	2,225
Kansas	2.698	2,471	2,763	2,632	2,793	2,802	2,624	2,749	2,620	2,629	2,537	2,448	31,766	56,131
Kentucky	700	706.4	779.8	742.2	801	762.1	781.7	791.4	745	762.2	721.4	680	8,973.2	17,758
Louisiana:														
Gulf coast	143	131	146	132	131	126	141	149	149	160	163	176	1,747	2,187
Northern	2,864	2,941	3,950	2,602	2,589	2,728	2,824	2,806	2,743	2,727	2,467	2,388	33,629	50,982
Total Louisiana	3,007	3,072	4,096	2,734	2,720	2,854	2,965	2,955	2,892	2,887	2,630	2,564	35,376	53,169
Montana	151	132	166	155	151	195	229	264	256	261	247	242	2,449	4,048
New York	77	73	80	78	95	85	85	83	94	85	85	80	1,000	3,144
Ohio:														
Central and eastern	365	364	410	375	422	408	389	418	396	415	393	396	4,751	12,804
Northwestern	146	154	177	165	182	182	176	181	170	178	161	158	2,030	4,565
Total Ohio	511	518	587	540	604	590	565	599	566	593	554	554	6,781	17,369
Oklahoma	10,241	10,252	12,208	12,265	13.218	13,171	13,585	13,118	12,527	12,897	12,724	13,365	149,571	258,160
Pennsylvania	540	558	629	597	660	638	620	667	628	662	629	597	7,425	23,834
Tennessee	1	.6	1.2	.8	1	.9	.3	.6	1	.8	.6	1	9.8	17
Texas:														
Gulf coast	3,131	2,792	2,836	2,864	3,020	2,874	2,837	2,961	2,898	3,135	2,989	3,033	35,370	42,126
Rest of State	8,566	7,820	8,223	7,890	7,003	6,603	6,684	6,531	6,098	6,200	5,852	5,844	83,314	147,049
Total Texas	11,697	10,612	11,059	10,754	10,023	9,477	9,521	9,492	8,996	9,335	8,841	8,877	118,684	189,175

[a] Total annual production of "clean oil," from California State Mining Bureau. Monthly figures for California prorated on basis of monthly reports by American Petroleum Institute.

Petroleum produced in the United States, 1922–1923, by States—Continued

[Thousands of barrels of 42 U. S. gallons]

State	January	February	March	April	May	June	July	August	September	October	November	December	The year	Value at wells (thousands of dollars)
West Virginia	549	565	648	593	548	702	565	606	557	566	542	580	7,021	22,891
Wyoming	1,680.5	1,517.6	1,900.4	2,047.2	2,323	2,314.4	2,255.4	2,188.8	2,232.5	2,646.3	2,702.4	2,906.5	26,715	33,955
Other [b]	1	1	1	1	1	1	1	1	1	1	1	2	13	33
United States	43,696	41,314	47,188	45,167	47,002	46,087	47,134	47,059	45,805	48,410	48,027	50,642	557,531	895,111
1923														
Arkansas	2,830	2,281	3,222	3,117	3,463	3,287	3,092	3,042	3,282	3,273	2,911	2,810	36,610	25,400
California [a]	16,362	16,327	19,485	20,570	21,409	22,528	25,232	26,417	25,744	24,546	22,384	21,872	[a] 262,876	[a] 242,731
Colorado	6.9	5.5	5.8	6.4	9.1	7.5	6.9	8.2	7.9	7.6	7.7	6.5	86	102
Illinois	773	643	807	662	784	739	745	747	696	733	693	685	8,707	16,250
Indiana:														
Southwestern	71	60	64	69	73	70	68	70	63	64	62	59	793	1,440
Northeastern	21	16	19	19	19	20	22	25	24	27	18	20	250	460
Total Indiana	92	76	83	88	92	90	90	95	87	91	80	79	1,043	1,900
Kansas	2,463	2,155	2,549	2,681	2,812	2,595	2,300	2,005	1,821	2,164	2,371	2,334	28,250	45,970
Kentucky	746.3	643.3	675.4	674.4	670	683.3	611.7	736	670.7	685.3	628.3	639.3	8,069	15,900
Louisiana:														
Gulf coast	202	183	217	204	214	209	208	208	210	204	197	194	2,450	3,340
Northern	2,185	1,876	2,190	2,026	2,046	1,849	1,887	1,868	1,687	1,687	1,588	1,580	22,469	33,190
Total Louisiana	2,387	2,059	2,407	2,230	2,260	2,058	2,095	2,076	1,897	1,891	1,785	1,774	24,919	36,530
Montana	255	209	234	249	225	225	271	280	276	211	169	178	2,782	4,080
New York	88	76	90	99	106	104	110	105	140	115	105	112	1,250	4,140
Ohio:														
Central and eastern	413	349	424	414	434	411	422	421	404	436	403	400	4,931	12,690
Northwestern	173	141	187	177	193	195	188	188	182	190	171	169	2,154	4,360
Total Ohio	586	490	611	591	627	606	610	609	586	626	574	569	7,085	17,050
Oklahoma	12,716	11,988	13,639	14,843	15,818	15,888	14,586	13,058	11,711	11,939	12,508	12,235	160,929	279,700
Pennsylvania	644	523	667	650	700	655	643	652	603	673	594	605	7,609	25,320
Tennessee	.7	.7	.6	.6	1	.7	.3	1	.3	.7	.7	.7	8	14

Texas:														
Gulf coast	3,058	2,479	2,568	2,478	2,657	2,635	2,683	2,733	2,540	2,476	2,255	2,259	30,821	42,780
Rest of State	6,063	5,386	6,232	6,093	6,533	6,633	8,132	9,117	10,532	13,345	13,504	8,632	100,202	150,800
Total Texas	9,121	7,865	8,800	8,571	9,190	9,268	10,815	11,850	13,072	15,821	15,759	10,891	131,023	193,580
West Virginia	515	472	571	528	582	544	538	559	503	575	477	494	6,358	20,822
Wyoming	2,940.1	2,773.5	3,120.2	3,446.6	3,626.9	3,560.5	4,177.1	4,179.8	4,208.1	4,152.4	4,340.3	4,259.5	44,785	48,900
Other [b]	1	1	2	1	2	1	2	2	1	2	1	2	18	41
United States	52,527	48,588	56,969	59,008	62,377	62,845	65,925	66,422	65,306	67,506	65,388	59,546	732,407	978,430

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[a] Total annual production of "clean oil," from California State Mining Bureau. Monthly figures for California prorated on basis of monthly reports by the American Petroleum Institute.

[b] Alaska, Missouri, and New Mexico.

Petroleum produced in Kentucky and Pennsylvania, 1922–1923, in barrels, by counties

Kentucky[a]			Pennsylvania[b]		
County	1922	1923	County	1922	1923
Allen	641, 556	476, 980	Allegheny	574, 552	561, 398
Barren	68, 702	81, 046	Armstrong	24, 788	24, 266
Bath	17, 622	17, 131	Beaver	117, 914	109, 140
Boyd	1, 252	1, 029	Butler	825, 366	781, 402
Cumberland	11, 806	21, 908	Clarion	212, 206	210, 914
Elliott	------------	395	Crawford	48, 406	59, 024
Estill	729, 393	588, 642	Elk	109, 244	101, 642
Floyd	4, 834	5, 278	Forest	87, 226	82, 707
Hancock	2, 625	31, 398	Greene	317, 343	274, 229
Hopkins	------------	4, 903	Jefferson	10, 036	9, 237
Jackson	2, 299	1, 896	Lawrence	31, 825	28, 654
Johnson	666, 758	1, 015, 006	McKean	2, 466, 723	2, 490, 696
Knott	3, 113	3, 194	Mercer	12, 954	13, 643
Lawrence	402, 196	467, 042	Potter	13, 375	12, 135
Lee	3, 429, 481	2, 655, 285	Tioga	8, 779	7, 712
Lincoln	633	500	Venango	1, 360, 093	1, 304, 206
Logan	3, 766	567	Warren	516, 781	522, 107
Magoffin	1, 234, 373	1, 348, 623	Washington	499, 893	474, 765
Martin	190	25	Westmoreland	233	215
McCreary	6, 399	5, 276			
Menifee	13, 297	5, 683		7, 237, 737	7, 068, 092
Monroe	68	10, 819	U. S. Geological Survey	7, 425, 000	7, 609, 000
Morgan	11, 126	9, 223			
Ohio	1, 266	9, 789			
Owsley	------------	2, 528			
Powell	207, 124	282, 393			
Russell	2, 235	6, 828			
Simpson	62, 810	22, 319			
Warren	1, 112, 245	762, 036			
Wayne	189, 615	142, 168			
Whitley	265	120			
Wolfe	86, 651	67, 440			
	8, 913, 700	8, 047, 470			
U. S. Geological Survey	8, 973, 200	8, 069, 000			

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[a] Kentucky State Tax Commission.

[b] Department of Internal Affairs, Pennsylvania.

Petroleum produced in Texas, 1914–1923, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Gulf coast (salt-dome pools)															
	Batson	Blue Ridge	Damon Mound	Dayton	Goose Creek	Hull	Humble	Markham	Orange	Pierce Junction	Saratoga	Sourlake	Spindletop	West Columbia	Other	Total
1914	776			19	135		2, 799	163	43		890	5, 209	580		3	10, 617
1915	704			10	119		11, 062	137	22		864	4, 115	388		48	17, 469
1916	745			9	397		10, 926	157	18		781	4, 923	341		45	18, 342
1917	693		[a] 124	10	7, 300		7, 390	127	7		683	4, 763	380	([a])	36	21, 513
1918	635		[a] 283	9	8, 944	245	6, 555	65			722	3, 408	557	([a])	47	21, 470
1919	560		191	8	5, 770	1, 273	3, 706	54			737	2, 709	407	5, 611	31	21, 057
1920	527	92	379	17	4, 476	3, 909	3, 607	57			849	2, 024	322	9, 459	17	25, 735
1921	495	326	666	40	4, 640	8, 150	3, 004	49	470	1, 239	1, 129	1, 802	344	12, 081	6	34, 441
1922	434	349	754	29	4, 766	6, 546	2, 284	35	5, 345	1, 020	713	1, 675	289	11, 126	5	35, 370
1923	403	287	628	35	6, 026	7, 300	2, 275	21	4, 649	313	626	1, 906	326	5, 994	32	30, 821

Year	Rest of State										Total for State
	East and south-central Texas							North-central Texas [b]	West Texas	Total	
	Corsicana, Currie, Mexia, Powell	Luling	Somerset	Thrall-Minerva	Webb-Zapata	Other	Total				
1914	416					181	597	8, 854		9, 451	20, 068
1915	381			613		123	1, 117	6, 357		7, 474	24, 943
1916	361			433		65	859	8, 444		9, 303	27, 645
1917	329			177		58	564	10, 336		10, 900	32, 413
1918	313			137		48	498	16, 782		17, 280	38, 750
1919	269		43	91		60	463	57, 846		58, 309	79, 366
1920	297		162	60		51	570	70, 563		71, 133	96, 868
1921	6, 137		324	52		48	6, 561	65, 164		71, 725	106, 166
1922	34, 790		672	37	733	35	36, 267	47, 037	10	83, 314	118, 684
1923	50, 827	2, 248	1, 030	247	1, 786	38	56, 176	43, 896	130	100, 202	131, 023

[a] Damon Mound includes West Columbia.

[b] Includes the districts in and between Wilbarger, Wichita, and Clay counties on the north and Coleman, Brown, and Comanche counties on the south.

Petroleum produced in coastal Texas salt-dome pools, 1923, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
Batson	30	20	36	30	35	35	35	35	34	36	30	33	389	14	403
Blue Ridge	19	16	14	15	24	55	21	27	23	21	16	14	265	22	287
Damon Mound	62	58	60	51	56	54	51	48	45	48	45	45	623	5	628
Dayton	4	2	3	2	3	3	2	3	2	3	4	3	34	1	35
Goose Creek	554	506	550	549	563	526	515	434	439	412	367	387	5, 802	224	6, 026
Hull	840	523	490	500	529	510	560	709	620	610	534	530	6, 955	345	7, 300
Humble	198	186	203	192	192	175	179	179	165	166	139	140	2, 114	161	2, 275
Markham	1	2	2	2	2	2	1	2	2	2	1	1	20	1	21
Orange	342	302	315	294	327	420	440	494	425	401	392	353	4, 505	144	4, 649
Pierce Junction	19	20	17	42	25	25	19	14	13	18	17	26	255	58	313
Saratoga	53	43	53	49	48	48	49	48	48	48	45	41	573	53	626
Sourlake	141	123	148	157	174	175	180	162	161	150	131	137	1, 839	67	1, 906
Spindletop	25	23	26	26	28	29	29	27	29	27	27	28	324	2	326
West Columbia	641	537	523	445	523	454	473	422	409	405	383	392	5, 607	387	5, 994
Other	1	-----	-----	-----	-----	-----	1	1	1	1	-----	1	6	26	32
	2, 930	2, 361	2, 440	2, 354	2, 529	2, 511	2, 555	2, 605	2, 416	2, 348	2, 131	2, 131	29, 311	1, 510	30, 821

Petroleum produced in east and south-central, north-central, and west Texas, 1919–1923, by districts and months

[Thousands of barrels of 42 U. S. gallons]

	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1919															
East and south-central Texas:															
Corsicana	23	20	23	22	25	23	20	20	22	29	17	20	264	5	269
Somerset	5	4	6	5	7	2	2	2	3	2	2	2	42	1	43
Thrall	9	8	9	7	8	8	8	7	7	8	6	6	91	------	91
Other	4	4	4	4	4	4	4	4	4	4	4	4	48	12	60
	41	36	42	38	44	37	34	33	36	43	29	32	445	18	463
North-central Texas	2, 586	2, 692	3, 171	3, 245	3, 499	4, 432	5, 982	6, 332	6, 277	6, 220	6, 448	6, 179	57, 063	783	57, 846
	2, 627	2, 728	3, 213	3, 283	3, 543	4, 469	6, 016	6, 365	6, 313	6, 263	6, 477	6, 211	57, 508	801	58, 309
1920															
East and south-central Texas:															
Corsicana	22	19	24	23	23	23	23	22	30	22	22	21	274	23	297
Somerset	6	8	9	14	11	11	13	18	17	19	18	12	156	6	162
Thrall	6	5	6	6	5	6	3	6	4	4	5	3	59	1	60
Other	3	4	4	3	4	3	4	4	4	4	3	4	44	7	51
	37	36	43	46	43	43	43	50	55	49	48	40	533	37	570
North-central Texas	5, 741	5, 139	5, 362	5, 016	5, 582	5, 845	5, 966	6, 098	5, 688	6, 610	6, 663	6, 709	70, 419	144	70, 563
	5, 778	5, 175	5, 405	5, 062	5, 625	5, 888	6, 009	6, 148	5, 743	6, 659	6, 711	6, 749	70, 952	181	71, 133

Petroleum produced in east and south-central, north-central, and west Texas, 1919–1923, by districts and months—Continued

[Thousands of barrels of 42 U. S. gallons]

	Petroleum transported from producing properties														
	January	February	March	April	May	June	July	August	September	October	November	December	The year	Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
1921															
East and south-central Texas:															
Corsicana-Mexia	24	17	23	22	87	135	23	23	24	333	1, 561	3, 079	5, 351	786	6, 137
Somerset	22	22	25	23	21	24	27	30	29	26	26	26	301	23	324
Thrall	4	6	4	4	4	5	4	4	3	5	5	3	51	1	52
Other	4	4	4	4	4	4	5	3	3	5	4	3	47	1	48
	54	49	56	53	116	168	59	60	59	369	1, 596	3, 111	5, 750	811	6, 561
North-central Texas	6, 365	5, 725	6, 665	6, 125	6, 112	5, 674	5, 464	5, 205	4, 651	4, 477	4, 312	4, 367	65, 142	22	65, 164
	6, 419	5, 774	6, 721	6, 178	6, 228	5, 842	5, 523	5, 265	4, 710	4, 846	5, 908	7, 478	70, 892	833	71, 725
1922															
East and south-central Texas:															
Corsicana-Currie-Mexia	4, 377	4, 106	4, 314	4, 185	2, 732	2, 226	2, 190	2, 166	2, 096	2, 097	1, 973	1, 876	34, 338	452	34, 790
Somerset	47	46	21	41	49	56	58	61	63	67	74	85	668	4	672
Thrall	4	4	3	4	3	3	3	3	3	3	3	2	38	−1	37
Webb-Zapata	13	12	14	23	37	44	67	78	92	112	115	123	730	3	733
Other	3	4	3	3	4	3	3	3	2	3	2	3	36	−1	35
	4, 444	4, 172	4, 355	4, 256	2, 825	2, 332	2, 321	2, 311	2, 256	2, 282	2, 167	2, 089	35, 810	457	36, 267
North-central Texas	4, 084	3, 613	3, 828	3, 597	4, 140	4, 234	4, 325	4, 182	3, 805	3, 880	3, 648	3, 714	47, 050	−13	47, 037
West Texas	-----	-----	2	-----	-----	-----	-----	-----	------	------	------	3	5	5	10
	8, 528	7, 785	8, 185	7, 853	6, 965	6, 566	6, 646	6, 493	6, 061	6, 162	5, 815	5, 806	82, 865	449	83, 314
1923															
East and south-central Texas:															
Corsicana-Currie-Mexia-Powell	2, 036	1, 845	2, 170	1, 876	1, 973	2, 090	3, 723	4, 990	6, 543	9, 189	9, 256	4, 477	50, 168	659	50, 827
Luling	-----	-----	-----	-----	-----	-----	63	231	419	500	477	467	2, 157	91	2, 248
Somerset	81	74	99	97	90	87	90	87	82	79	77	81	1, 024	6	1, 030
Thrall-Minerva	21	19	19	21	22	22	22	22	20	20	19	20	247	------	247
Webb-Zapata	130	135	122	135	140	173	141	160	164	173	134	147	1, 754	32	1, 786
Other	3	3	3	3	3	3	4	3	3	3	3	3	37	1	38
	2, 271	2, 076	2, 413	2, 132	2, 228	2, 375	4, 043	5, 493	7, 231	9, 964	9, 966	5, 195	55, 387	789	56, 176
North-central Texas	3, 693	3, 223	3, 722	3, 865	4, 206	4, 159	3, 988	3, 522	3, 196	3, 271	3, 428	3, 324	43, 597	299	43, 896
West Texas	6	3	4	6	6	8	8	9	14	17	19	20	120	10	130
	5, 970	5, 302	6, 139	6, 003	6, 440	6, 542	8, 039	9, 024	10, 441	13, 252	13, 413	8, 539	99, 104	1, 098	100, 202

Petroleum produced in Louisiana, 1914–1923, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Gulf coast (salt-dome pools)						Northern									Total for State
	Anse la Butte	Edgerley	Jennings	Vinton	Other	Total	Bellevue	Caddo	De Soto	Elm Grove	Haynesville	Homer	Red River (Bull Bayou, Crichton)	Other	Total	
1914	19	586	412	1, 465	19	2, 501	------	7, 572	3, 834	----	------	------	402	----	11, 808	14, 309
1915	21	1, 403	435	1, 234	17	3, 110	------	6, 472	1, 797	----	------	------	6, 802	11	15, 082	18, 192
1916	13	1, 252	517	1, 640	4	3, 426	------	5, 464	1, 657	----	------	------	4, 691	10	11, 822	15, 248
1917	5	806	399	1, 595	25	2, 830	------	5, 483	1, 371	----	------	------	1, 665	43	8, 562	11, 392
1918	[a] 3	512	369	1, 839	15	2, 738	------	11 144	1, 066	----	------	------	1, 046	49	13, 305	16, 043
1919	----	361	347	1, 592	9	2, 309	------	[a] 8, 700	[a] 1, 200	----	------	[a] 2, 000	[a] 2, 900	79	14, 879	17, 188
1920	----	379	232	1, 333	3	1, 947	------	6, 336	([b])	----	------	21, 508	[b] 5, 923	----	33, 767	35, 714
1921	47	250	254	1, 379	----	1, 930	------	5, 342	719	----	3, 161	13, 030	2, 844	77	25, 173	27, 103
1922	36	125	191	1, 395	----	1, 747	1, 050	4, 498	531	160	19, 939	5, 673	1, 778	----	33, 629	35, 376
1923	18	157	204	2, 071	----	2, 450	2, 351	4, 178	429	220	10, 496	3, 581	1, 207	7	22, 469	24, 919

[a] Estimated.

[b] De Soto included under Red River.

Petroleum produced in Louisiana, 1923, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1–Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
Gulf coast (salt-dome pools)															
Anse la Butte	2	2	1	1	2	1	2	2	1	1	1	1	17	1	18
Edgerley	13	10	11	13	17	11	12	10	11	11	8	8	135	22	157
Jennings	14	13	14	14	13	15	15	17	19	16	18	16	184	20	204
Vinton	156	143	173	160	164	166	162	162	163	159	154	152	1, 914	157	2, 071
	185	168	199	188	196	193	191	191	194	187	181	177	2, 250	200	2, 450
Northern															
Bellevue	170	145	204	209	195	153	205	231	191	165	124	164	2, 156	195	2, 351
Caddo	361	314	371	338	359	339	344	357	331	370	371	315	4, 170	8	4, 178
DeSoto	40	39	43	38	38	35	35	35	34	33	33	31	434	−5	429
Elm Grove	13	15	18	15	24	20	25	21	19	14	20	20	224	−4	220
Haynesville	1, 123	958	1, 107	1, 009	994	889	859	815	718	708	674	672	10, 526	−30	10, 496
Homer	345	294	330	301	317	302	303	295	286	283	258	273	3, 587	−6	3, 581
Red River (Bull Bayou, Crichton)	137	116	123	121	124	115	120	119	111	114	112	110	1, 422	−215	1, 207
Other	-----	-----	-----	-----	-----	-----	-----	-----	2	4	1	-----	7	------	7
	2, 189	1, 881	2, 196	2, 031	2, 051	1, 853	1, 891	1, 873	1, 692	1, 691	1, 593	1, 585	22, 526	−57	22, 469

Petroleum produced in Arkansas, 1921–1923, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	El Dorado	Smackover	Stephens	Total
1921	10, 473	----------	----------	10, 473
1922	10, 592	2, 107	13	12, 712
1923	5, 830	30, 048	[a] 732	36, 610

[a] Includes Irma.

Petroleum produced in Arkansas, 1922–1923, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
1922															
El Dorado	1, 100	985	1, 035	1, 084	1, 056	943	921	826	685	698	641	541	10, 515	77	10, 592
Smackover	-----	-----	-----	-----	-----	-----	-----	-----	1	153	376	1, 039	1, 569	538	2, 107
Stephens	-----	-----	-----	-----	-----	-----	-----	3	2	4	3	1	13	-------	13
	1, 100	985	1, 035	1, 084	1, 056	943	921	829	688	855	1, 020	1, 581	12, 097	615	12, 712
1923															
El Dorado	494	418	636	619	592	517	515	476	413	407	359	350	5, 796	34	5, 830
Smackover	2, 187	1, 728	2, 429	2, 342	2, 698	2, 585	2, 371	2, 334	2, 648	2, 638	2, 335	2, 240	28, 535	1, 513	30, 048
Stephens	7	7	14	19	31	48	64	89	84	86	80	78	607	[a] 125	[a] 732
	2, 688	2, 153	3, 079	2, 980	3, 321	3, 150	2, 950	2, 899	3, 145	3, 131	2, 774	2, 668	34, 938	1, 672	36, 610

[a] Includes Irma.

Petroleum produced in Colorado, 1914–1923, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Boulder	Florence	Other	Total	Year	Boulder	Florence	Other	Total
1914	6	216	1	223	1919	5	102	14	121
1915	6	202	--------	208	1920	7	88	16	111
1916	6	191	--------	197	1921	5	83	20	108
1917	6	114	1	121	1922	4	70	23	97
1918	4	135	4	143	1923	3. 8	62	20. 2	86

Petroleum transported from producing properties in Colorado, 1923, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	The year
Boulder	0. 4	0. 2	0. 3	0. 3	0. 3	0. 3	0. 3	0. 4	0. 3	0. 3	0. 3	0. 4	3. 8
Florence	5. 9	4. 6	5. 5	5. 6	6. 1	5. 1	4. 3	5. 0	5. 2	5. 0	5. 4	4. 3	62. 0
Rangely	. 6	. 7	------	. 5	2. 7	2. 1	2. 3	2. 8	2. 4	2. 3	2. 0	1. 8	20. 2
	6. 9	5. 5	5. 8	6. 4	9. 1	7. 5	6. 9	8. 2	7. 9	7. 6	7. 7	6. 5	86. 0

Petroleum produced in Wyoming, 1914–1923, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Big Muddy	Byron-Greybull-Torchlight	Elk Basin	Grass Creek	Hamilton Dome-Warm Springs	Lance Creek	Lander-Dallas	Lost Soldier-Ferris
1914	----------	96	----------	----------	----------	----------	27	----------
1915	([a])	141	----------	99	----------	----------	28	----------
1916	([a])	140	721	1, 370	----------	----------	[b] 63	----------
1917	665	62	1, 530	2, 756	----------	----------	[b] 50	----------
1918	3, 082	45	1, 067	2, 951	----------	----------	48	----------
1919	3, 104	27	740	2, 049	----------	461	62	167
1920	2, 083	69	732	1, 573	57	353	84	135
1921	1, 927	80	681	1, 435	67	346	119	524
1922	1, 506	70	652	1, 784	111	282	149	751
1923	1, 527	57	634. 4	1, 589	216	363	137	1, 551

Year	Mule Creek	Osage	Pilot Butte	Rock Creek	Salt Creek	Teapot	Other	Total
1914	----------	----------	----------	----------	3, 421	----------	16	3, 560
1915	----------	----------	----------	----------	3, 971	----------	7	4, 246
1916	----------	----------	([b])	----------	3, 933	----------	7	6, 234
1917	----------	----------	([b])	----------	3, 911	----------	4	8, 978
1918	----------	----------	62	----------	5, 337	----------	4	12, 596
1919	----------	----------	91	242	6, 225	----------	4	13, 172
1920	182	16	69	1, 370	10, 090	----------	18	16, 831
1921	68	176	46	1, 681	12, 172	----------	11	19, 333
1922	168	182	38	1, 728	19, 248	37	9	26, 715
1923	----------	178	29	1, 429	35, 770	1, 156	148. 6	44, 785

[a] Included under "Other."

[b] Pilot Butte included with Lander-Dallas.

Petroleum produced in Wyoming, 1923, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1-Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
Big Muddy	111	114	136	136	137	138	148	115	125	126	132	115	1, 533	−6	1, 527
Byron-Greybull-Torchlight	6	5	6	5	5	4	3	4	3	3	2	3	49	8	57
Elk Basin	51	42. 5	49. 1	56. 5	59. 8	57. 4	56. 9	58. 8	55. 5	53. 4	47	41. 5	629. 4	5	634. 4
Grass Creek	131	109	129	147	155	153	158	158	144	115	98	93	1, 590	−1	1, 589
Hamilton Dome	21	--------	26	29	--------	31	18	20	16	18	24	16	219	−3	216
Lance Creek	20	18	19	18	28	26	22	21	19	18	68	83	360	3	363
Lander-Dallas	12	10	14	14	13	14	12	12	16	13	13	12	155	−18	137
Lost Soldier-Ferris	62	22	36	160	181	153	166	141	123	164	200	211	1, 619	−68	1, 551
Osage	21	15	18	17	19	15	14	15	8	14	15	9	180	−2	178
Pilot Butte	2	2	2	3	2	3	1	4	2	3	1	2	27	2	29
Rock Creek	121	121	129	132	124	125	126	127	116	116	103	96	1, 436	−7	1, 429
Salt Creek	2, 332	2, 269	2, 498	2, 668	2, 764	2, 699	3, 304	3, 344	3, 423	3, 318	3, 463	3, 413	35, 495	275	35, 770
Teapot	30	28	38	42	119	123	116	124	128	138	131	120	1, 137	19	1, 156
Other	--------	--------	--------	--------	--------	--------	12. 2	15	10. 1	34	23. 3	25	119. 6	29	148. 6
	2, 920	2, 755. 5	3, 100. 1	3, 427. 5	3, 606. 8	3, 541. 4	4, 157. 1	4, 158. 8	4, 188. 6	4, 133. 4	4, 320. 3	4, 239. 5	44, 549	236	44, 785

Petroleum produced in Montana, 1916–1923, by districts

[Thousands of barrels of 42 U. S. gallons]

Year	Cat Creek	Elk Basin	Kevin-Sunburst	Other	Total
1916	---	45	---	---	45
1917	---	100	---	---	100
1918	---	69	---	---	69
1919	---	90	---	---	90
1920	243	97	---	---	340
1921	1,408	75	---	26	1,509
1922	2,333	46	36	34	2,449
1923	2,227	28	523	4	2,782

Petroleum produced in Montana, 1923, by districts and months

[Thousands of barrels of 42 U. S. gallons]

District	Petroleum transported from producing properties													Oil consumed on leases plus net change in producers' stocks, Jan. 1–Dec. 31	Production
	January	February	March	April	May	June	July	August	September	October	November	December	The year		
Cat Creek	215	180	197	199	194	167	169	164	158	157	139	148	2,087	140	2,227
Elk Basin	3	2	2	2	2	2	3	2	3	2	3	2	28	---	28
Kevin-Sunburst	18	10	16	30	10	38	80	95	97	33	8	9	444	79	523
Other	---	---	---	---	---	---	---	---	---	---	---	---	---	4	4
	236	192	215	231	206	207	252	261	258	192	150	159	2,559	223	2,782

Petroleum produced in California in 1923, by fields

[Barrels of "clean oil," from State Mining Bureau]

Field	Jan. 1 to June 30	July 1 to Dec. 31	Total
District No. 1:			
Beverly Hills	81,838	85,715	167,553
Brea Olinda	1,807,901	1,904,027	3,711,928
Coyote Hills	2,232,911	547,234	2,780,145
Dominguez	---	167,836	167,836
Huntington Beach	17,952,556	15,860,629	33,813,185
Long Beach	26,507,886	41,393,116	67,901,002
Montebello	2,070,294	1,919,589	3,989,883
Newhall	31,480	27,456	58,936
Richfield	3,283,180	2,886,483	6,169,663
Salt Lake	394,054	400,501	794,555
Santa Fe Springs	31,752,818	49,711,597	81,464,415
Torrance	592,490	2,563,226	3,155,716
Whittier	367,974	368,489	736,463
	87,075,382	117,835,898	204,911,280
Los Angeles City field	(a)	(a)	229,069
District No. 2:			
Bardsdale	196,301	184,915	381,216
Conejo	510	255	765
Ojai	36,225	41,139	77,364
Piru	58,698	59,831	118,529
Santa Paula	19,448	14,121	33,569
Sespe	24,902	21,483	46,385
Simi	38,824	36,575	75,399
South Mountain	738,554	721,701	1,460,255
Ventura	712,306	705,006	1,417,312
	1,825,768	1,785,026	3,610,794

[a] Semiannual figures for Los Angeles City field not available.

Petroleum produced in California in 1923, by fields—Continued

[Barrels of "clean oil," from State Mining Bureau]

Field	Jan. 1 to June 30	July 1 to Dec. 31	Total
District No. 3:			
Arroyo Grande	17,406	15,582	32,988
Casmalia	575,273	505,330	1,080,603
Cat Canyon	254,618	281,220	535,838
Half Moon Bay	[b] 388	[b] 388	776
Lompoc	75,050	40,345	115,395
Santa Maria	624,788	653,123	1,277,911
Sargent	7,340	7,160	14,500
Summerland	[b] 26,100	[b] 26,100	52,200
	1,580,963	1,529,248	3,110,211
District No. 4:			
Belridge-Lost Hills-Devils Den	1,130,088	666,984	1,797,072
Elk Hills	4,016,230	4,071,319	8,087,549
Kern River	3,524,969	3,045,871	6,570,840
McKittrick-Temblor	1,107,872	1,098,859	2,206,731
Midway-Sunset	13,848,475	13,306,250	27,154,725
Wheeler Ridge	43,706	92,171	135,877
	23,671,340	22,281,454	45,952,794
District No. 5: Coalinga	2,412,869	2,648,673	5,061,542
Grand total	([a])	([a])	262,875,690

[a] Semiannual figures for Los Angeles City field not available.

[b] Estimated.

Petroleum produced in California, 1919–1923, by counties [a]

[Thousands of barrels of 42 U. S. gallons]

County	1919	1920	1921	1922	1923
Fresno	16,091	15,375	12,162	9,266	5,061
Kern	47,734	50,660	57,435	53,512	45,953
Los Angeles	15,077	14,026	12,396	37,726	158,665
Orange	14,459	15,463	22,929	31,049	46,475
San Luis Obispo	31	43	31	34	33
San Mateo					([b])
Santa Barbara	6,089	5,804	5,466	3,931	3,062
Santa Clara	17	16	14	16	[b] 16
Ventura	1,685	1,990	2,167	2,934	3,611
	101,183	103,377	112,600	138,468	262,876

[a] California State Mining Bureau.

[b] San Mateo County included with Santa Clara.

WORLD'S PRODUCTION

The world's production of petroleum in 1923 for the first time in the history of the industry exceeded 1,000,000,000 barrels. (See Pl. V.) The greatly increased rate of production in recent years is emphasized by the fact that the output in 1923 was more than double that in 1918. The increase of 160 million barrels (19 per cent) over the output of 1922 was due to the increased production of the United States; in other countries the decreases more than offset the gains. The chief decrease in production was in Mexico, where there was a decline of 32,693,000 barrels, or 18 per cent, compared with 1922. Minor decreases in production are reported in Japan, India, Egypt, France, Germany, Canada, and Czechoslovakia. The largest gains during 1923, outside of the United States, were in Persia, Russia, the Dutch East Indies, Venezuela, British Borneo, and Rumania, in each of which there was an increase of more than a million barrels. Smaller gains are reported for Trinidad, Argentina, Peru, Poland, Colombia, and Italy.

By its record output the United States increased its ratio of the total world's production from 65 per cent in 1922 to 72 per cent in 1923. The output of Mexico, on the other hand, dropped from 21 per cent of the world's total to 15 per cent; other percentage changes were fractional.

There were no changes in rank of the oil-producing countries down through Poland, which is ninth in order; but there were several changes among the smaller producing countries. Venezuela advanced from thirteenth to tenth place, passing Trinidad, British Borneo, and Argentina; France and Colombia changed places, Colombia making a gain of 31 per cent and exceeding the output of France by 21,000 barrels.

Mexico's production in 1923 marks the second year of its decline in output from the maximum of 193,398,000 barrels attained in 1921. Continued decreased production is reported in the Tampico-Tuxpam or southern field, in which the so-called light oil, having an approximate average gravity of 20° (0.934), is produced. For a number of years this field produced considerably more than the Pánuco Valley or northern field, in which heavy oil having an approximate average gravity of 12° (0.986) is produced, but in 1923 these conditions were reversed. In that year 61 million barrels of light oil and 89 million barrels of heavy oil was produced, as contrasted with a production of 136 million barrels of light oil and 46 million barrels of heavy oil in 1922.

Petroleum produced in Mexico, by fields, 1923 [a]

Field	Barrels	Field	Barrels
Heavy oil:		Light oil:	
Ebano	2,630,585	Filisola	2,566
El Limón	5,799	Furbero	62,919
Molino	623	Ixhuatlán	2,151
Pánuco	81,791,468	Potrero del Llano	2,040,357
San Jerónimo	468,907	Sarlat	182
Topila	3,644,250	Tanhuijo	654
		Tantoyuca	4,730
	88,541,632	Tepetate-Chinampa-Amatlán-Zacamixtle	14,671,118
Light oil:		Tierra Amarilla	58,692
Alazán	533,776	Tierra Blanca, Chapopote y Alamo	17,087,370
Cerro Viejo	1,690,985	Toteco-Cerro Azul	24,478,560
Chiconcillo y San Miguel	408,988		
Concepción	176		61,043,224

[a] Boletín del petróleo, vol. 17, No. 1, p. 56, January, 1924.

Information concerning conditions in Russia is contained in a recent report[12] from which the following statement and table are quoted:

> The Russian petroleum industry * * * has been struggling with ignorance, inappreciation, and political strife at home and the competition of highly organized distribution in the world's markets. During the revolutionary period of 1917 and 1918 much damage was caused to the oil properties, and the nationalized industry started with great handicaps in the form of lack of labor, equipment, and technical personnel. However, largely because of the richness of the Russian deposits, the industry has revived so that in 1924 it is beginning to export its products in appreciable quantities to the petroleum markets of Europe. There it is coming in competition with American products.

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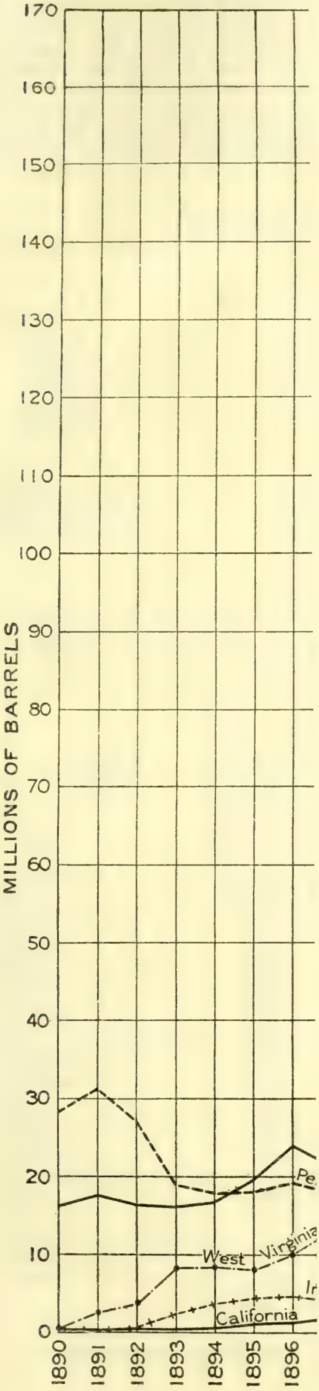
[12] Otis, W. A., The petroleum industry of Russia: U. S. Dept. Commerce Trade Inf. Bull. 263, August 25, 1924.


MILLIONS OF BARRELS
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Pe
West Virginia
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California
1890
1891
1892
1893
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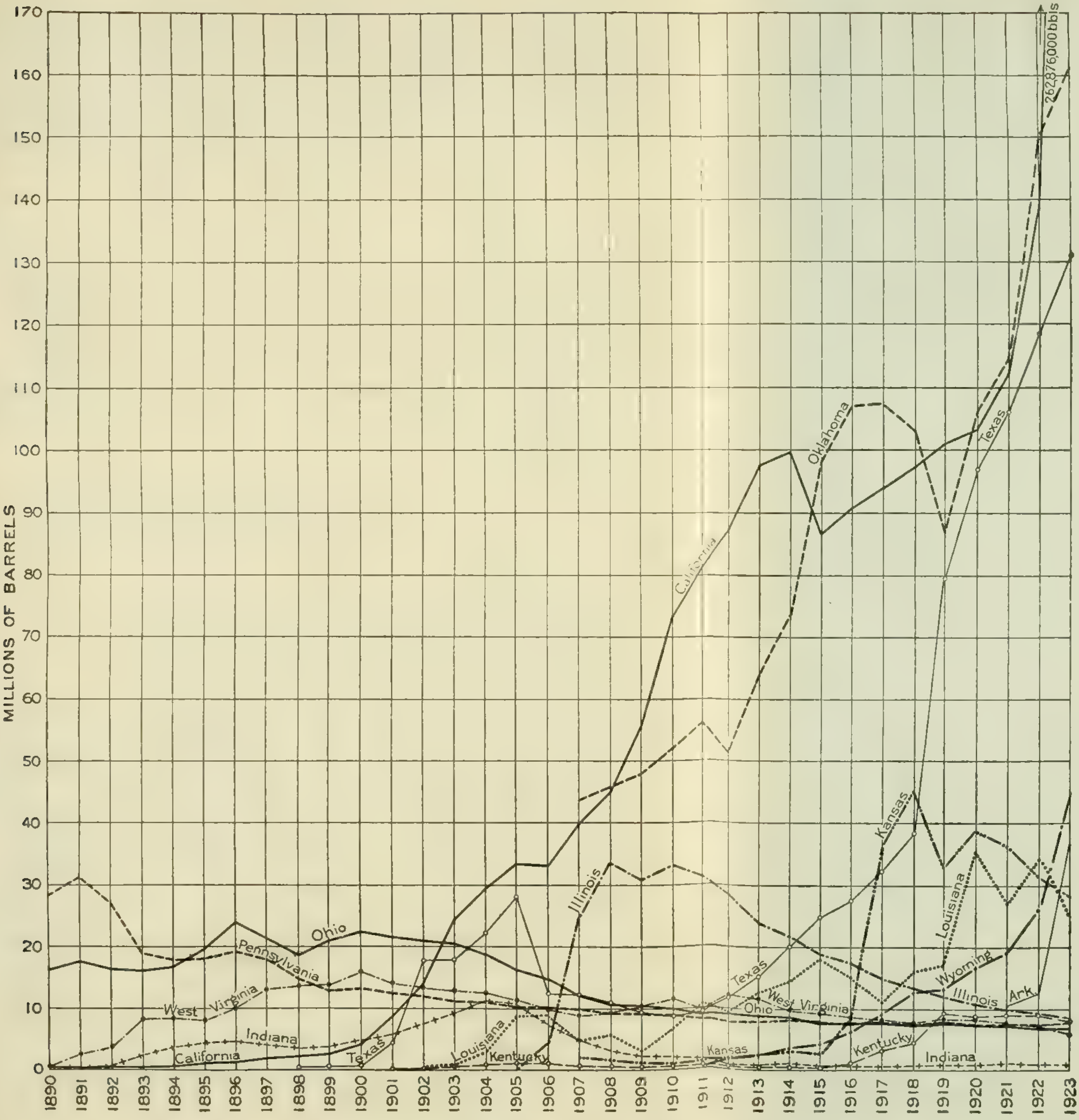
1895
1896

PRODUCT



PRODUCTION CURVES OF THE PRINCIPAL OIL-PRODUCING STATES, 1890–1923

The petroleum deposits constitute one of the most important of the many national resources of Russia and are destined to play a very important part in the reconstruction of that country. How large a part depends on the success the industry will attain in reducing cost of production and transportation. The latter is perhaps the factor which will affect most the competition of Russian oil in Europe. The railroads and water routes will have to be rehabilitated before advantage can be taken of the proximity to the markets. Until considerable capital is expended for this purpose the revenues from the foreign trade of the Russian petroleum industry will not be great and its competition on European markets not serious to the trade in general.

Petroleum produced in Russia, by fields, 1923 [a]

	Poods	Barrels
Baku:		
Romani	25, 450, 800	3, 076, 678
Balakhani	31, 490, 500	3, 492, 665
Sabunchi	62, 662, 600	7, 144, 008
Bibi-Eibat	41, 316, 800	4, 902, 637
Surakhani	51, 029, 100	6, 669, 462
Binagadi	12, 225, 000	1, 373, 915
Atashka	6, 008, 000	689, 088
	230, 182, 800	27, 348, 453
Grozny	89, 588, 100	10, 460, 262
Emba Ural	7, 714, 900	853, 776
Kuban-Black Sea	3, 019, 800	338, 595
Ferghana	1, 292, 200	155, 112
	331, 797, 800	39, 156, 198

[a] Petroleum Bull., year 2, No. 16, Annex, Moscow, 1924.

World's production of petroleum in 1923, and total production, 1857–1923 [a]

Country	1923				1857–1923			
	Thousands of barrels of 42 U. S. gallons	Thousands of metric tons	Thousands of cubic meters	Percentage of total by volume	Thousands of barrels of 42 U. S. gallons	Thousands of metric tons	Thousands of cubic meters	Percentage of total by volume
United States	732, 407	100, 371	116, 440	71. 9	7, 191, 989	985, 195	1, 143, 384	63. 2
Mexico	149, 585	22, 704	23, 781	14. 7	1, 061, 784	159, 040	168, 802	9. 3
Russia	39, 156	5, 435	6, 225	3. 8	2, 007, 837	266, 320	319, 206	17. 6
Persia	28, 326	3, 774	4, 503	2. 8	118, 245	15, 763	18, 799	1. 0
Dutch East Indies	19, 868	2, 833	3, 159	1. 9	273, 555	37, 330	43, 490	2. 4
Rumania	10, 867	1, 512	1, 728	1. 1	194, 539	27, 302	30, 928	1. 7
India	8, 320	1, 168	1, 323	. 8	149, 044	19, 990	23, 695	1. 3
Peru	5, 699	752	906	. 6	44, 509	5, 910	7, 077	. 4
Poland	5, 402	737	859	. 5	184, 976	25, 571	29, 408	1. 6
Venezuela	4, 201	639	668	. 4	9, 170	1, 395	1, 458	1. 5
British Borneo (Sarawak)	3, 940	567	626	. 4	12, 342	1, 776	1, 962	
Argentina	3, 400	497	540	. 3	15, 752	2, 299	2, 504	
Trinidad	3, 051	424	485	. 3	19, 207	2, 671	3, 053	
Japan and Taiwan	1, 805	251	287	. 2	47, 681	6, 623	7, 580	
Egypt	1, 054	153	170	. 3	10, 636	1, 531	1, 693	
Colombia	424	61	67		747	107	118	
France	403	57	64		2, 341	330	372	
Germany	312	44	50		16, 299	2, 197	2, 592	
Canada	170	23	27		25, 400	3, 388	4, 038	
Czechoslovakia	74	11	12		405	60	65	
Italy	34	5	5		1, 141	162	181	
Barbados	10	16	19		(b)	(b)	(b)	
Algeria	9				59	8	9	
Cuba	4				688	94	111	
England	1							
Other (estimate)	98							
	1, 018, 620	142, 034	161, 944	100. 0	11, 388, 346	1, 565, 062	1, 810, 525	100. 0

[a] Compiled by W. I. Whiteside, U. S. Geological Survey.

[b] Included under "Other."

World's production of crude petroleum,

[Thousands of barrels

Year	Rumania	United States	Italy	Canada	Russia	Poland (Galicia)	Japan and Taiwan	Germany	India	Dutch East Indies	Peru	Mexico	Argentina
1857-60	19	502	(a)	------	------	------	------	------	------	------	------	------	------
1861	17	2,114	(a)	------	------	------	------	------	------	------	------	------	------
1862	23	3,057	(a)	12	------	------	------	------	------	------	------	------	------
1863	28	2,611	(a)	83	41	------	------	------	------	------	------	------	------
1864	33	2,116	(a)	90	65	------	------	------	------	------	------	------	------
1865	39	2,498	2	110	67	------	------	------	------	------	------	------	------
1866	42	3,598	1	175	83	------	------	------	------	------	------	------	------
1867	51	3,347	1	190	120	------	------	------	------	------	------	------	------
1868	56	3,646	(a)	200	88	------	------	------	------	------	------	------	------
1869	59	4,215	(a)	220	202	------	------	------	------	------	------	------	------
1870	84	5,261	(a)	250	204	------	------	------	------	------	------	------	------
1871	90	5,205	(a)	270	165	------	------	------	------	------	------	------	------
1872	91	6,293	(a)	308	185	------	------	------	------	------	------	------	------
1873	104	9,894	(a)	365	475	------	------	------	------	------	------	------	------
1874	103	10,927	1	169	583	150	------	------	------	------	------	------	------
1875	108	8,788	1	220	697	158	5	------	------	------	------	------	------
1876	111	9,133	3	312	1,321	164	7	------	------	------	------	------	------
1877	108	13,350	3	312	1,801	170	10	------	------	------	------	------	------
1878	109	15,397	4	312	2,401	176	18	------	------	------	------	------	------
1879	110	19,914	3	575	2,761	215	23	------	------	------	------	------	------
1880	115	26,286	2	350	3,001	229	26	9	------	------	------	------	------
1881	122	27,661	1	275	3,601	287	17	29	------	------	------	------	------
1882	136	30,350	2	275	4,538	330	15	58	------	------	------	------	------
1883	139	23,450	2	250	6,002	365	20	27	------	------	------	------	------
1884	211	24,218	3	250	10,805	408	28	46	------	------	------	------	------
1885	193	21,859	2	250	13,925	465	30	41	------	------	------	------	------
1886	168	28,065	2	584	18,006	306	38	74	------	------	------	------	------
1887	182	28,283	1	526	18,368	344	29	74	------	------	------	------	------
1888	219	27,612	1	695	23,049	467	37	85	------	------	------	------	------
1889	298	35,164	1	705	24,609	515	53	68	94	------	------	------	------
1890	383	45,824	3	795	28,691	659	52	108	118	------	------	------	------
1891	488	54,293	8	755	34,573	631	53	109	190	------	------	------	------
1892	593	50,515	18	780	35,775	646	69	101	242	------	------	------	------
1893	535	48,431	19	798	40,457	693	106	100	299	600	------	------	------
1894	508	49,344	21	829	36,375	949	173	123	327	688	------	------	------
1895	576	52,892	26	726	46,140	1,453	170	121	372	1,216	------	------	------
1896	543	60,960	18	727	47,221	2,444	237	145	430	1,427	47	------	------
1897	571	60,476	14	710	54,399	2,226	262	166	546	2,552	71	------	------
1898	776	55,364	15	758	61,610	2,376	319	184	542	2,964	71	------	------
1899	1,426	57,071	16	808	65,955	2,314	539	192	941	1,796	89	------	------
1900	1,629	63,621	12	913	75,780	2,347	871	358	1,079	2,253	274	------	------
1901	1,678	69,389	16	757	85,168	3,251	1,117	314	1,431	4,014	275	10	------
1902	2,060	88,767	19	531	80,540	4,142	996	354	1,617	2,430	287	40	------
1903	2,763	100,461	18	487	75,591	5,235	1,209	446	2,510	5,770	278	75	------
1904	3,599	117,081	26	553	78,537	5,947	1,219	637	3,385	6,508	290	126	------
1905	4,421	134,717	44	634	54,960	5,766	1,347	561	4,137	7,850	373	251	------
1906	6,378	126,494	54	569	58,897	5,468	1,564	579	4,016	8,181	531	502	------
1907	8,118	166,095	60	789	61,851	8,456	1,718	757	4,344	9,983	751	1,005	(a)
1908	8,252	178,527	51	528	62,187	12,612	1,871	1,009	5,047	10,283	945	3,933	12
1909	9,327	183,171	42	421	65,970	14,933	1,887	1,019	6,677	11,042	1,411	2,714	18
1910	9,724	209,557	51	316	70,337	12,673	1,829	1,032	6,138	11,031	1,258	3,634	20
1911	11,108	220,449	75	291	66,184	10,519	1,737	1,017	6,451	12,173	1,465	12,553	13
1912	12,976	222,935	54	243	68,019	8,535	1,659	1,031	7,117	10,846	1,752	16,558	47
1913	13,555	248,446	47	228	62,834	7,818	1,940	857	7,930	11,172	2,071	25,696	131
1914	12,827	265,763	40	215	67,020	6,436	2,636	781	7,410	11,422	1,837	26,235	276
1915	12,030	281,104	44	215	68,548	5,352	2,928	703	8,202	11,920	2,579	32,911	513
1916	8,945	300,767	51	198	65,817	6,587	2,963	656	8,491	12,547	2,593	40,546	867
1917	3,721	335,316	41	214	63,072	6,228	2,861	642	8,079	13,180	2,577	55,293	1,218
1918	8,730	355,928	35	305	27,168	6,032	2,441	270	8,188	12,778	2,527	63,828	1,353
1919	6,618	378,367	35	241	31,752	6,096	2,238	265	8,736	15,508	2,628	87,073	1,331
1920	7,435	442,929	35	196	25,430	5,607	2,221	246	8,375	17,529	2,817	163,540	1,651
1921	8,368	472,183	32	188	28,968	5,167	2,233	274	8,734	16,958	3,699	193,398	2,036
1922	9,843	557,531	31	179	35,692	5,227	2,055	319	8,529	17,066	5,314	182,278	2,866
1923	10,867	732,407	34	170	39,156	5,402	1,805	312	8,320	19,868	5,699	149,585	3,400
	194,539	7,191,989	1,141	25,400	2,007,837	184,976	47,681	16,299	149,044	273,555	44,509	1,061,784	15,752

[a] Less than 1 thousand. [b] Estimated. [c] Cuba. [d] Production in previous years credited to Germany.

1857–1923, by years and countries

of 42 U. S. gallons]

Trinidad	Egypt	Persia	Sarawak	Algeria	Venezuela	France	England	Czechoslovakia	Colombia	Other countries	Total	Percentage produced by United States	Year
------	------	------	------	------	------	------	------	------	------	------	521	96	1857–1860
------	------	------	------	------	------	------	------	------	------	------	2, 131	99	1861
------	------	------	------	------	------	------	------	------	------	------	3, 092	99	1862
------	------	------	------	------	------	------	------	------	------	------	2, 763	94	1863
------	------	------	------	------	------	------	------	------	------	------	2, 304	92	1864
------	------	------	------	------	------	------	------	------	------	------	2, 716	92	1865
------	------	------	------	------	------	------	------	------	------	------	3, 899	92	1866
------	------	------	------	------	------	------	------	------	------	------	3, 709	90	1867
------	------	------	------	------	------	------	------	------	------	------	3, 990	91	1868
------	------	------	------	------	------	------	------	------	------	------	4, 696	90	1869
------	------	------	------	------	------	------	------	------	------	------	5, 799	91	1870
------	------	------	------	------	------	------	------	------	------	------	5, 730	91	1871
------	------	------	------	------	------	------	------	------	------	------	6, 877	92	1872
------	------	------	------	------	------	------	------	------	------	------	10, 838	91	1873
------	------	------	------	------	------	------	------	------	------	------	11, 933	92	1874
------	------	------	------	------	------	------	------	------	------	------	9, 977	88	1875
------	------	------	------	------	------	------	------	------	------	------	11, 051	83	1876
------	------	------	------	------	------	------	------	------	------	------	15, 754	85	1877
------	------	------	------	------	------	------	------	------	------	------	18, 417	84	1878
------	------	------	------	------	------	------	------	------	------	------	23, 601	84	1879
------	------	------	------	------	------	------	------	------	------	------	30, 018	88	1880
------	------	------	------	------	------	------	------	------	------	------	31, 993	86	1881
------	------	------	------	------	------	------	------	------	------	------	35, 704	85	1882
------	------	------	------	------	------	------	------	------	------	------	30, 255	78	1883
------	------	------	------	------	------	------	------	------	------	------	35, 969	67	1884
------	------	------	------	------	------	------	------	------	------	------	36, 765	59	1885
------	------	------	------	------	------	------	------	------	------	------	47, 243	59	1886
------	------	------	------	------	------	------	------	------	------	------	47, 807	59	1887
------	------	------	------	------	------	------	------	------	------	------	52, 165	53	1888
------	------	------	------	------	------	------	------	------	------	------	61, 507	57	1889
------	------	------	------	------	------	------	------	------	------	------	76, 633	60	1890
------	------	------	------	------	------	------	------	------	------	------	91, 100	60	1891
------	------	------	------	------	------	------	------	------	------	------	88, 739	57	1892
------	------	------	------	------	------	------	------	------	------	------	92, 038	53	1893
------	------	------	------	------	------	------	------	------	------	------	89, 337	55	1894
------	------	------	------	------	------	------	------	------	------	------	103, 692	51	1895
------	------	------	------	------	------	------	------	------	------	------	114, 199	53	1896
------	------	------	------	------	------	------	------	------	------	------	121, 993	50	1897
------	------	------	------	------	------	------	------	------	------	------	124, 979	44	1898
------	------	------	------	------	------	------	------	------	------	------	131, 147	44	1899
------	------	------	------	------	------	------	------	------	------	------	149, 137	43	1900
------	------	------	------	------	------	------	------	------	------	[b] 20	167, 440	41	1901
------	------	------	------	------	------	------	------	------	------	[b] 26	181, 809	49	1902
------	------	------	------	------	------	------	------	------	------	[b] 36	194, 879	52	1903
------	------	------	------	------	------	------	------	------	------	[b] 40	217, 948	54	1904
------	------	------	------	------	------	------	------	------	------	[b] 30	215, 091	63	1905
------	------	------	------	------	------	------	------	------	------	[b] 30	213, 263	59	1906
------	------	------	------	------	------	------	------	------	------	[b] 30	263, 957	63	1907
(e)	------	------	------	------	------	------	------	------	------	[b] 30	285 287	63	1908
57	------	------	------	------	------	------	------	------	------	[b] 20	298, 709	61	1909
143	------	------	------	------	------	------	------	------	------	[b] 20	327, 763	64	1910
285	21	------	------	------	------	------	------	------	------	[b] 20	344, 361	64	1911
437	214	------	------	------	------	------	------	------	------	[b] 20	352, 443	63	1912
504	98	1, 857	141	------	------	------	------	------	------	[b] 20	385, 345	64	1913
644	753	2, 910	318	1	------	------	------	------	------	[b] 20	407, 544	65	1914
750	212	3, 616	392	4	------	------	------	------	------	[b] 10	432, 033	65	1915
929	404	4, 477	629	8	------	------	------	------	------	[b] 25	457, 500	66	1916
1, 602	943	7, 147	542	9	120	------	------	------	------	[c] 19	502, 824	67	1917
2, 082	1, 935	8, 623	504	7	333	[d] 363	------	------	------	------	503, 430	71	1918
1, 841	1, 517	10, 139	596	5	425	334	2	48	------	------	555, 795	68	1919
2, 083	1, 042	12, 230	1, 020	4	457	356	3	69	------	------	695, 275	64	1920
2, 354	1, 255	16, 673	1, 411	3	1, 433	389	3	94	------	[e] 50	765, 903	62	1921
2, 445	1, 188	22, 247	2, 849	9	2, 201	496	1	120	323	[b] 100	858, 909	65	1922
3, 051	1, 054	28, 326	3, 940	9	4, 201	403	1	74	424	[f] 112	1, 018, 620	72	1923
19, 207	**10, 636**	**118, 245**	**12, 342**	**59**	**9, 170**	**2, 341**	**10**	**405**	**747**	**678**	**11, 388, 346**	**63**	

[e] Ecuador.

[f] Including 4,000 barrels from Cuba and 10,000 barrels from Barbados.

IMPORTS AND EXPORTS OF CRUDE PETROLEUM

The statistics of imports and exports of crude petroleum and shipments to territories given in the following tables, unless otherwise specified, have been compiled by J. A. Dorsey, of the United States Geological Survey, from records of the Bureau of Foreign and Domestic Commerce, in which some topped oil is included with crude oil. Similar data for refined products of petroleum are given with refinery statistics on page 425.

The imports for the year were 45 million barrels less than in 1922. The decrease was due to a falling off in the production of Mexico, from which more than 95 per cent of the imports are derived. Peru ranked second in 1923 as a source of imported crude oil. As noted on page 369, the falling off in imports was more than counterbalanced by receipts of California crude oil at Atlantic and Gulf coast ports.

Exports of crude oil increased 7 million barrels over those in 1922. As in former years, most of the exports of crude oil went to Canada, but the quantity exported to Canada for a number of years has been between 6 and 9 million barrels, and the increase in 1923 was due chiefly to greater exports to Mexico. These exports were almost if not quite all from California, and, together with decreased exports from Mexico to the United States and decreased production in Mexico, they emphasize the changed conditions in that country.

Crude petroleum imported, exported, and shipped to Territories, 1914–1923 [a]

Year	Imports		Exports	
	Barrels	Value	Barrels	Value
1914	16, 913, 121	$10, 023, 097	2, 969, 894	$4, 958, 838
1915	18, 139, 338	10, 387, 553	3, 768, 168	4, 282, 827
1916	20, 796, 865	12, 574, 266	4, 095, 902	7, 029, 923
1917	30, 126, 683	16, 255, 279	4, 098, 124	7, 668, 312
1918	37, 735, 641	21, 319, 464	4, 900, 691	12, 084, 250
1919	52, 821, 567	26, 442, 881	[b] 6, 018, 651	14, 848, 066
1920	106, 175, 289	55, 799, 254	[b] 8, 757, 092	29, 986, 874
1921	125, 363, 983	66, 547, 379	[b] 8, 939, 633	20, 261, 898
1922	127, 308, 423	70, 383, 309	[b] 10, 162, 817	18, 422, 231
1923	82, 015, 025	53, 882, 259	[b] 17, 385, 378	23, 262, 190

Year	Shipments to Territories from United States					
	Alaska		Hawaii		Porto Rico	
	Barrels	Value	Barrels	Value	Barrels	Value
1914	415, 560	$319, 512	1, 614, 633	$1, 201, 445	10	$50
1915	332, 623	268, 474	1, 636, 669	1, 174, 284	23	85
1916	446, 097	397, 337	1, 610, 112	1, 383, 433	940	2, 836
1917	482, 218	635, 480	1, 644, 357	1, 988, 508	3, 404	11, 007
1918	222, 639	343, 596	759, 167	1, 041, 337	1, 289	5, 148
1919	71	422	328, 805	552, 690	4	18
1920	447	2, 838	537, 116	1, 083, 954	174	746
1921	----------	----------	687, 173	1, 393, 831	6	50
1922	----------	----------	641, 721	1, 060, 445	233	1, 343
1923	2, 741	13, 713	146, 482	161, 198	----------	----------

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[a] Compiled from records of the Bureau of Foreign and Domestic Commerce.

[b] Includes exports of foreign crude oil. Corresponding exports not included in figures prior to 1919, They were, however, negligible.

Crude petroleum imported and exported, 1922–1923, by months[a]

[Thousands of barrels of 42 U. S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	The year	
													Thousands of barrels	Value (thousands of dollars)
1922														
Imports:														
By countries—														
Canada											1		1	1
"Dutch West Indies"	71					78	79	76	[b] 78	[c] 121	232		735	771
Mexico	13,036	12,077	14,004	11,659	13,950	12,104	10,339	10,203	[b] 4,674	[c] 9,919	7,189	7,041	126,195	69,313
Other countries					68		75		[b] 60	[c] 42	7	125	377	298
	13,107	12,077	14,004	11,659	14,018	12,182	10,493	10,279	[b] 4,812	[c] 10,082	7,429	7,166	127,308	70,383
By ports of entry—														
Atlantic coast	6,390	5,964	8,498	5,056	7,517	5,816	5,296	5,786	[b] 2,887	[c] 5,025	4,220	4,644	67,099	36,227
Gulf coast	6,672	6,078	5,466	6,578	6,501	6,334	5,152	4,493	[b] 1,846	[c] 4,990	3,141	2,492	59,743	33,893
Pacific coast	10			5					[b] 19	[c] 7	8		49	42
Mexican border	35	35	40	20		32	45		[b] 60	[c] 60	60	30	417	221
	13,107	12,077	14,004	11,659	14,018	12,182	10,493	10,279	[b] 4,812	[c] 10,082	7,429	7,166	127,308	70,383
Exports:														
Domestic crude oil—														
Argentina		83											83	83
Canada	651	430	562	785	595	695	624	605	931	713	591	1,012	8,194	13,890
Cuba	69	66	105	55	105	50	107	52					609	2,344
England						52					136		188	580
Germany			88	76	45		68		75		113	30	495	885
Japan												52	52	52
Mexico					1	2		2		1	11	14	31	19
Panama								53	65				118	118
Other countries			43	3	9	16	84	31	34		5		225	377
Foreign crude oil	7	4	8	5	16	11	10	21	22	27	23	14	168	74
	727	583	806	924	771	826	893	764	1,127	741	879	1,122	10,163	18,422
Excess of imports over exports	12,380	11,494	13,198	10,735	13,247	11,356	9,600	9,515	[b] 3,685	[c] 9,341	6,550	6,044	117,145	51,961

[a] Compiled from records of Bureau of Foreign and Domestic Commerce.

[b] Imports cover Sept. 1 to 21.

[c] Imports cover Sept. 22 to Oct. 31.

Crude petroleum imported and exported, 1922–1923, by months—Continued

[Thousands of barrels of 42 U. S. gallons]

	January	February	March	April	May	June	July	August	September	October	November	December	The year	
													Thousands of barrels	Value (thousands of dollars)
1923														
Imports:														
By countries—														
Canada		1		71									72	64
"Dutch West Indies"	156		78	76			74	68		144		214	810	880
Mexico	6,540	6,198	7,289	6,391	5,929	5,996	6,771	7,341	6,021	6,681	6,085	8,112	79,354	51,708
Peru	611		532	79			70	171				91	1,554	1,073
Other countries			159		66								225	157
	7,307	6,199	8,058	6,617	5,995	5,996	6,915	7,580	6,021	6,825	6,085	8,417	82,015	53,882
By ports of entry—														
Atlantic coast	4,350	3,133	3,957	3,207	2,653	2,920	3,739	3,810	2,777	3,820	2,780	3,865	41,011	27,953
Gulf coast	2,957	3,035	4,054	3,409	3,250	3,076	3,176	3,770	3,244	3,005	3,305	4,552	40,833	25,832
Pacific coast		1		1									2	5
Mexican border		30	47		92								169	92
	7,307	6,199	8,058	6,617	5,995	5,996	6,915	7,580	6,021	6,825	6,085	8,417	82,015	53,882
Exports:														
Domestic crude oil—														
Argentina	58		92	70		155	80	60	90	90	120	103	918	1,014
Canada	644	410	611	818	717	1,033	583	734	795	830	662	989	8,826	12,990
Cuba					27			56	55	62	69	64	333	855
England		50		50		72	61						233	408
Germany		59		93		61	29	12	78				332	679
Japan			52	64	64	60	63	53	64		124		544	545
Mexico	17	113	249	384	495	927	375	492	424	190	388	817	4,871	4,618
Panama	29					70	79	21	55			55	309	340
Peru							85	77		90			252	252
Other countries		4			3	195	163	6		30	1	41	443	1,411
Foreign crude oil	14	30	24	32	18	25	29	31	31	23	33	34	324	150
	762	666	1,028	1,511	1,324	2,598	1,547	1,542	1,592	1,315	1,397	2,103	17,385	23,262
Excess of imports over exports	6,545	5,533	7,030	5,106	4,671	3,398	5,368	6,038	4,429	5,510	4,688	6,314	64,630	30,620

STOCKS

In this report stocks of crude petroleum are classified as follows:

1. Producers' stocks, or petroleum held on the producing properties (lease or "field" storage). Producers' stocks are reported to the Geological Survey annually.

2. Pipe-line and tank-farm stocks, or petroleum that has been transported from the producing properties but not delivered at refineries or at other points of consumption. For the States east of California such stocks are reported monthly to the Geological Survey as gross stocks, including the total contents of tanks and pipe lines, and as net stocks, which are gross stocks minus sediment and water. The stocks reported for California are compiled by the Pacific coast office of the American Petroleum Institute and include producers', pipe-line, and tank-farm stocks (but not refinery stocks) of crude oil, residuum, and tops.

3. Refinery and other consumers' stocks, or petroleum that has been delivered at refineries and at other points of consumption. Stocks of crude petroleum held at refineries are compiled by the Bureau of Mines. Data concerning stocks held by other consumers are not available.

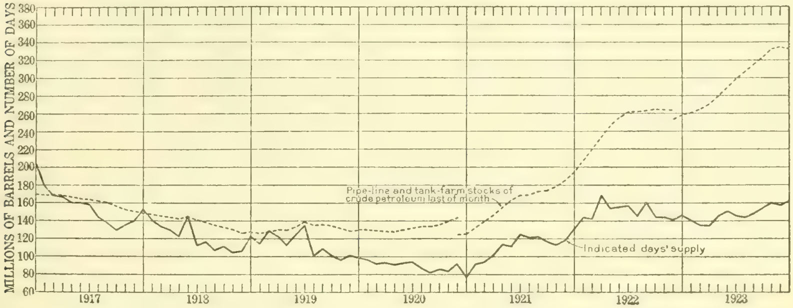

FIGURE 17.—Pipe-line and tank-farm stocks of crude petroleum contrasted with indicated days' supply, 1917–1923

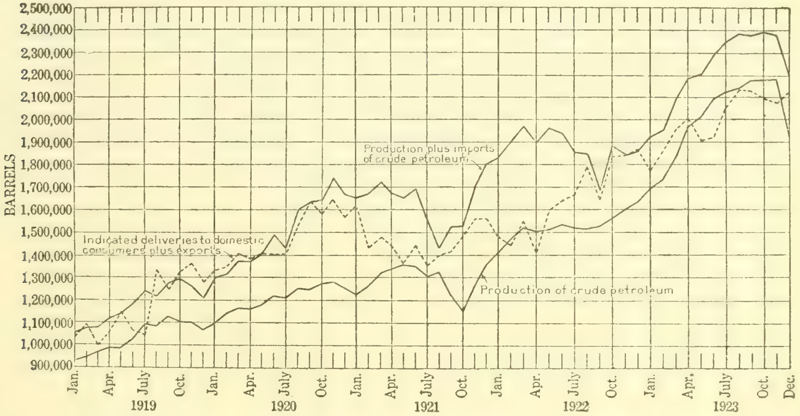

FIGURE 18.—Daily average production of petroleum, production plus imports, and indicated deliveries to domestic consumers plus exports, by months, 1919–1923

Prior to 1923 refinery stocks of domestic and foreign crude oil were not differentiated in statistical statements, and there was duplication in the reports of refinery stocks and stocks of foreign petroleum held in the United States by importers. This duplication has been eliminated since December, 1922. On December 31, 1922, 11,103,000 barrels of foreign petroleum (crude and topped oil topped in Mexico) was held by importers at refineries in the United States. The deduction of this duplicated oil explains the jog in the curve shown in Figure 17.

On December 31, 1918, shortly after the end of the war, stocks of crude petroleum, exclusive of consumers' stocks, had been reduced to 128,586,000 barrels, a supply sufficient for 113 days at the then current annual rate of deliveries to domestic consumers, plus exports. The previous high point was at the end of 1915, during the period of flush production of the Cushing field, when 194,185,000 barrels of crude oil was held in storage (exclusive of consumers' stocks), or enough for 241 days. Since 1918 stocks have increased greatly, and on December 31, 1923, producers', pipe-line, and tank-farm stocks of domestic crude petroleum and stocks of foreign petroleum held in the United States by importers elsewhere than at refineries amounted to 344,624,000 barrels. On account of the increased rate of consumption this record quantity was equivalent to an indicated supply for only 172 days. The fact that indicated days' supply, measured by the current monthly rate of deliveries to domestic consumers and exports, has not increased in proportion to stocks and in the later part of 1923 was less than during the first part of 1917, on account of the increase in the rate of consumption, is shown in Figure 17.

A summarized statement of stocks of crude oil, exclusive of refining stocks, held in the United States on December 31 of each year from 1914 to 1923 is given in the table below. Stocks held on the last day of each month for 1923 are shown in the table on page 404. Stocks of crude oil and of refined products held at refineries on December 31 of each year from 1918 to 1923 are given on page 425.

Stocks of crude petroleum held in the United States on December 31, 1914–1923

[Thousands of barrels of 42 U. S. gallons]

Year	Pipe-line and tank-farm stocks of domestic crude petroleum, by field of origin								Producers' stocks	Foreign petroleum held by importers (including topped oil topped in Mexico)[a]	Total	
	Appalachian field	Lima-Indiana field	Illinois-southwest Indiana field	Mid-Continent field	Gulf coast field	Rocky Mountain field	California field	Total			Quantity[b]	Days' supply[c]
1914	5,725	1,648	13,564	60,818	3,964	170	55,661	141,550	([d])	([d])	141,550	196
1915	5,742	2,919	11,328	[e]74,230	7,022	425	44,588	[e]146,254	[e]47,931	([d])	194,185	241
1916	3,850	2,088	6,600	[e]77,307	9,315	745	39,398	[e]139,303	[e]40,069	([d])	179,372	200
1917	3,821	1,906	3,560	[e]99,426	8,385	515	[f]32,450	[e]150,063	[g]9,389	([d])	159,452	152
1918	3,616	1,029	2,367	79,094	8,168	236	[f]32,043	126,553	[g]2,033	([d])	128,586	113
1919	3,757	1,122	4,395	76,712	12,575	164	[f]30,480	129,205	[g]4,089	2,919	136,213	117
1920	3,673	1,286	3,495	91,696	12,311	299	[f]22,240	135,000	[g]3,586	7,442	146,028	99
1920[h]	3,427	1,038	2,965	75,690	11,163	636	[f]22,240	117,159	[g]3,586	7,442	128,187	87
1921[i]	6,838	1,014	7,567	102,401	17,606	1,635	[f]35,022	172,083	[g]5,139	13,540	190,762	130
1922[i]	8,868	685	10,140	152,573	24,781	1,991	[j]49,375	248,413	[g]8,428	16,165	273,006	165
1923[i]	9,210	975	11,091	202,904	23,974	19,704	[j]62,162	330,020	[g]9,850	[a]4,754	344,624	172

[a] 1919 to 1922 includes stocks of foreign oil held at refineries, which on Dec. 31, 1922, amounted to 11,103,000 barrels. Figures for Dec. 31, 1923, include only foreign petroleum held by importers elsewhere than at refineries.

[b] For stocks of crude petroleum held at refineries see pp. 405 and 425.

[c] Based on average daily rate for the year of deliveries to domestic consumers and exports.

[d] Not reported.

[e] In 1915 and 1916 stocks held off producing properties by certain companies were classed as producers' stocks, but for subsequent years similar stocks are classed as tank-farm stocks.

[f] From Standard Oil Bulletin; include, in addition to gross pipe-line and tank-farm stocks, some unfinished products of topping plants that were turned back to pipe lines and also producers' stocks.

[g] Exclusive of producers' stocks in California.

[h] As reported by revised method; see U. S. Geol. Survey Mineral Resources, 1921, pt. 2, p. 284, 1923.

[i] Pipe-line and tank-farm stocks reported net.

[j] Producers', pipe-line, and tank-farm stocks (but not refinery stocks) of crude oil, residuum, and tops reported by American Petroleum Institute.

Stocks of crude petroleum held in the United States at end of each month in 1923

[Thousands of barrels of 42 U. S. gallons]

	Pipe-line and tank-farm stocks												Producers' stocks Dec. 31
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Domestic petroleum, by fields of origin:													
East of California:													
Appalachian:													
New York, Pennsylvania, West Virginia, eastern and central Ohio, Gross	6,232	6,360	6,523	6,337	6,231	6,313	6,426	6,472	6,443	6,611	6,560	6,606	506
New York, Pennsylvania, West Virginia, eastern and central Ohio, Net	5,972	6,102	6,264	6,079	5,973	6,053	6,165	6,262	6,150	6,333	6,284	6,331	
Kentucky, Gross	3,120	3,092	3,202	3,205	3,220	3,255	3,135	3,170	3,193	3,144	3,074	3,007	
Kentucky, Net	3,004	2,979	3,081	3,083	3,096	3,128	3,005	3,041	3,063	3,011	2,945	2,879	
Lima-Indiana, Gross	989	988	1,011	1,016	1,036	1,053	1,065	1,082	1,097	1,137	1,166	1,211	45
Lima-Indiana, Net	732	729	763	768	788	806	816	845	861	901	930	975	
Illinois-Southwestern Indiana, Gross	10,720	10,722	10,939	11,041	11,212	11,176	11,328	11,532	11,726	11,942	11,905	11,528	152
Illinois-Southwestern Indiana, Net	10,218	10,220	10,436	10,580	10,751	10,714	10,867	11,072	11,290	11,494	11,459	11,091	
Mid-Continent:													
Oklahoma, Kansas, central and north Texas, Gross	146,868	146,488	147,029	151,425	156,596	162,147	165,836	166,248	172,811	177,146	182,928	183,052	7,173
Oklahoma, Kansas, central and north Texas, Net	136,183	135,576	136,755	140,258	145,349	150,792	154,464	155,172	161,687	165,849	171,836	171,781	
North Louisiana and Arkansas, Gross	18,968	19,994	21,327	22,015	24,231	26,492	28,287	28,067	29,580	30,487	31,762	32,927	
North Louisiana and Arkansas, Net	18,276	19,267	20,467	21,204	23,362	25,585	27,359	27,135	28,061	28,917	29,101	31,123	
Gulf coast, Gross	25,992	24,491	23,946	23,668	23,931	24,017	23,942	24,314	24,637	24,950	25,077	24,355	990
Gulf coast, Net	24,865	24,090	23,615	23,290	23,547	23,631	23,565	23,942	24,227	24,602	24,726	23,974	
Rocky Mountain, Gross	[a] 5,173	5,548	6,381	7,214	8,202	9,132	10,080	12,392	14,217	15,836	17,987	19,718	984
Rocky Mountain, Net	[a] 5,154	5,529	6,376	7,214	8,201	9,128	10,077	12,387	14,207	15,826	17,977	19,704	
Total east of California, Gross	218,062	217,683	220,358	225,921	234,659	243,585	250,099	253,277	263,704	271,253	280,459	282,404	9,850
Total east of California, Net	204,404	204,492	207,757	212,476	221,067	229,837	236,318	239,856	249,546	256,933	265,258	267,858	
California[b]	49,516	52,085	53,036	53,720	54,258	56,428	59,047	63,240	60,941	62,668	63,423	62,162	8,240
Foreign petroleum held in the United States by importers elsewhere than at refineries:													
At Atlantic coast stations, Crude	308	290	265	235	154	217	176	174	170	230	318	324	----------
At Atlantic coast stations, Topped[c]	2,790	2,805	2,776	2,750	2,700	2,650	2,600	2,340	2,433	2,551	2,604	2,806	----------
At Gulf coast stations, Crude	340	423	447	374	493	520	627	819	750	772	789	1,059	----------
At Gulf coast stations, Topped[c]	839	622	618	600	600	600	600	671	653	635	495	565	----------
	4,277	4,140	4,106	3,959	3,947	3,987	4,003	4,004	4,006	4,188	4,206	4,754	----------
Total of net pipe-line and tank-farm stocks east of California; gross pipe-line, tank-farm, and producers' stocks in California; and stocks of foreign petroleum held in the United States by importers elsewhere than at refineries	258,197	260,717	264,899	270,155	279,272	290,252	299,368	307,100	314,493	323,789	332,887	334,774	----------

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[a] Includes 3,167,000 barrels formerly classed as refinery stocks.

[b] Producers', pipe-line, and tank-farm (but not refinery) stocks of crude oil, residuum, and tops (American Petroleum Institute).

[c] Topped oil topped in Mexico.

Stocks of crude petroleum held at refineries in the United States at the end of each month in 1923 [a]

[Thousands of barrels of 42 U. S. gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Domestic	19, 940	19, 194	22, 662	23, 354	24, 791	25, 383	27, 767	28, 898	28, 528	29, 995	30, 153	29, 756
Foreign	10, 274	8, 919	8, 471	7, 989	6, 720	6, 335	5, 814	5, 373	4, 225	3, 674	2, 859	3, 503
	29, 914	28, 113	31, 133	31, 343	31, 511	31, 718	33, 581	34, 271	32, 753	33, 669	33, 012	33, 259

[a] Bureau of Mines.

CONSUMPTION

Although petroleum is utilized chiefly in the form of refined products, concerning which summarized statistics are given on page 425, considerable crude oil, especially the heavier grades produced in the California, Gulf coast, and other domestic fields and heavy crude oil imported from Mexico, is consumed as such without topping or refining in any way. Complete data concerning these uses of crude oil, distinct from fuel oil, have not been compiled.

Besides runs to refinery stills, the only available figures of consumption of crude oil as such are those showing consumption in the operation of crude-oil pipe lines and consumption of oil on the producing properties given in the table on page 408. Figures showing indicated deliveries of crude petroleum to domestic consumers, by fields of origin of the oil, are given in the table below. A table showing indicated domestic consumption of crude petroleum, including runs to stills at refineries and the indicated other consumption of crude oil, chiefly for fuel, and including losses, is also given below.

The relation between supply of crude petroleum (production, imports, and stocks) and demand (indicated deliveries to consumers and exports) for a number of years is shown by Figures 18 and 19.

Annual deliveries to domestic consumers plus exports of domestic and foreign crude petroleum were greater than the quantity of domestic "petroleum marketed" from 1911 to 1918, except in 1914. They were greater than domestic "petroleum marketed" plus imports in 1916, 1917, and 1918, the result being that in these three years stocks were drawn upon. In 1919 and 1920 deliveries plus exports amounted to slightly less than combined production and imports, and in 1921 and 1922 they were considerably less, resulting in large additions to stocks. In 1923, because of the greatly increased production and in spite of record high consumption, deliveries plus exports were slightly less than domestic production (see fig. 18) and stocks were increased by more than 82½ million barrels, a quantity greater than the total imports of crude oil.

The monthly relation between the new supply (production and imports) and demand from January, 1919, to December, 1923, is illustrated in Figure 18. From October, 1919, to May, 1920, deliveries plus exports exceeded production plus imports. But from

June, 1920, through December, 1923, except only in December, 1922, for a period of 31 months, deliveries plus exports were not only less than production plus imports but for a period of seven months, from May to November, 1923, were less than production.

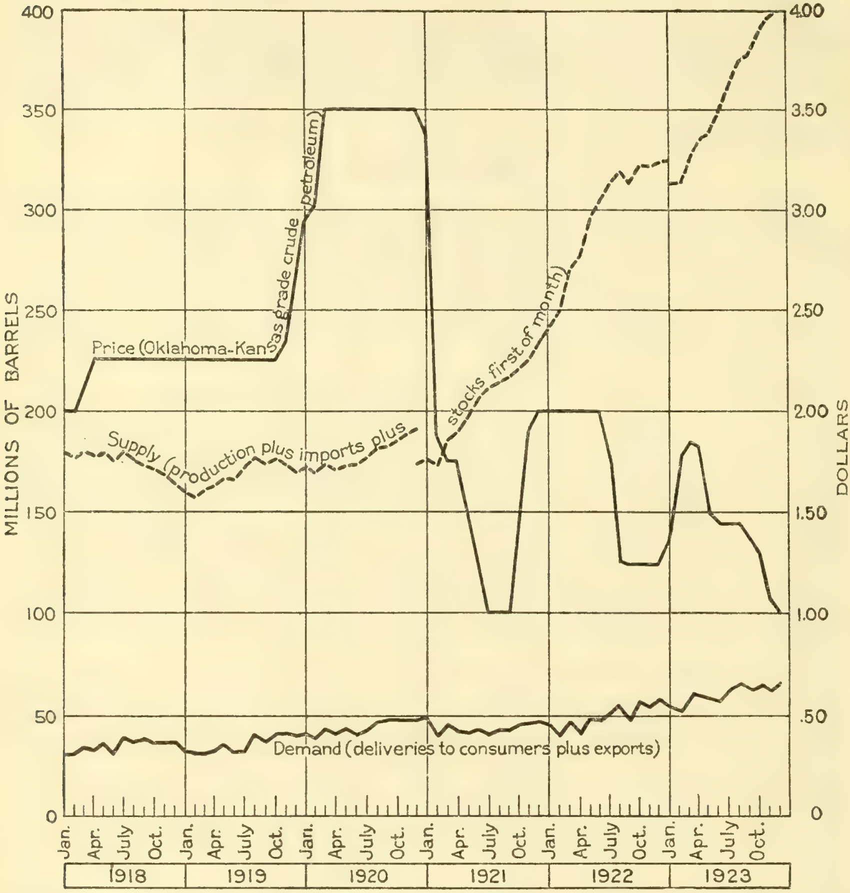

FIGURE 19.—Supply and demand for crude petroleum contrasted with price of Oklahoma-Kansas grade crude petroleum, 1918–1923

Indicated deliveries of crude petroleum to domestic consumers, 1923, by months

[Thousands of barrels of 42 U. S. gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	The year
Domestic petroleum, by fields of origin:													
Appalachian	2, 291	1, 952	2, 156	2, 541	2, 578	2, 283	2, 328	2, 333	2, 403	2, 346	2, 315	2, 262	27, 788
Lima-Indiana	148	161	173	192	193	198	201	185	191	178	161	145	2, 126
Illinois and southwestern Indiana	767	702	656	588	687	847	661	613	542	595	791	1, 114	8, 563
Mid-Continent	24, 279	23, 219	25, 361	24, 431	23, 332	22, 497	24, 460	28, 515	21, 503	27, 299	26, 622	25, 533	297, 051
Gulf coast	3, 178	3, 439	3, 262	3, 009	2, 616	2, 762	2, 959	2, 566	2, 467	2, 307	2, 330	3, 208	34, 103
Rocky Mountain	[a] 14	2, 590	2, 488	2, 839	2, 849	2, 841	3, 481	2, 133	2, 647	2, 726	2, 341	2, 691	29, 640
California	16, 221	13, 758	18, 534	19, 886	20, 871	20, 358	22, 613	22, 224	28, 043	22, 819	21, 629	23, 133	250, 089
Other	1	1	2	1	2	1	2	2	1	2	1	2	18
Deliveries and exports	46, 899	45, 822	52, 632	53, 487	53, 128	51, 787	56, 705	58, 571	57, 797	58, 272	56, 190	58, 088	649, 378
Exports of domestic crude oil	748	636	1, 004	1, 479	1, 306	2, 573	1, 518	1, 511	1, 561	1, 292	1, 364	2, 069	17, 061
Deliveries in the United States and Territories	46, 151	45, 186	51, 628	52, 008	51, 822	49, 214	55, 187	57, 060	56, 236	56, 980	54, 826	56, 019	632, 317
Foreign petroleum delivered in the United States and Territories	8, 078	6, 306	8, 068	6, 732	5, 989	5, 931	6, 870	7, 548	5, 988	6, 620	6, 034	7, 835	81, 999
	54, 229	51, 492	59, 696	58, 740	57, 811	55, 145	62, 057	64, 608	62, 224	63, 600	60, 860	63, 854	714, 316

[a] Calculated result due to reclassification of certain stocks by transfer from refinery to tank farm.

Indicated domestic consumption of crude petroleum, 1923, by months

[Thousands of barrels of 42 U. S. gallons]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	The year
Runs to refinery stills [a]	46, 825	42, 672	46, 819	46, 710	47, 973	47, 969	50, 926	50, 015	48, 812	50, 904	50, 364	51, 249	581, 238
Indicated other consumption, chiefly for fuel (including losses)	11, 295	10, 621	9, 857	11, 820	9, 670	6, 969	9, 268	13, 903	14, 930	11, 780	11, 153	12, 358	133, 624
	58, 120	53, 293	56, 676	58, 530	57, 643	54, 938	60, 194	63, 918	63, 742	62, 684	61, 517	63, 607	714, 862

[a] From Bureau of Mines.

Crude and fuel oil consumed for fuel, 1920–1923

[Thousands of barrels of 42 U. S. gallons]

	1920	1921	1922	1923
Crude oil:				
On producing oil properties [a]	4,647	4,261	5,747	4,316
In operation of oil pipe lines east of California [a]	([b])	1,668	1,767	1,715
Fuel and gas oil (including some crude oil):				
By locomotives (all services, class 1 carriers) [c]	45,945	39,558	43,527	47,143
By vessels operated by or for account of U. S. Shipping Board [d]—				
Domestic oil	2,000	3,361	17,515	19,129
Mexican oil	14,742	11,936		
Open-market purchase	4,185	3,824	714	
	20,927	19,121	18,229	19,129
By vessels cleared to foreign countries (bunker oil) [e]	26,335	27,076	31,692	37,582
By U. S. Navy (fiscal year) [f]	7,530	6,372	5,827	7,044
By electric public-utility power plants [g]	13,123	12,045	13,197	14,679
By manufacturers of gas	[g] 21,982	[h] 21,380	[g] [i] 20,381	[j] 22,156

[a] Reported to U. S. Geological Survey.
[b] Data not available.
[c] Interstate Commerce Commission.
[d] Estimated by U. S. Shipping Board Emergency Fleet Corporation.
[e] Bureau of Foreign and Domestic Commerce.
[f] Navy Department.
[g] U. S. Geological Survey.
[h] American Gas Association.
[i] Revised figures.
[j] Bureau of the Census.

The rapidly increasing number of motor vehicles and oil-burning vessels, as shown below, emphasizes the growth of the demand for liquid fuels for those purposes.

Motor-vehicle registration in the United States, 1910 and 1915–1923 [a]

[All figures represent thousands]

Year	Passenger cars, taxis, and busses [b]	Trucks and commercial cars [c]	Motor cycles	Total	Year	Passenger cars, taxis, and busses [b]	Trucks and commercial cars [c]	Motor cycles	Total
1910	([d])	([d])	([d])	500	1919	7,144	422	241	7,807
1915	2,373	73	199	2,645	1920	8,380	852	239	9,471
1916	3,394	119	251	3,764	1921	9,483	980	196	10,659
1917	4,792	191	258	5,241	1922	10,960	1,279	183	12,422
1918	5,853	294	241	6,388	1923	13,540	1,553	171	15,264

[a] Commerce Year Book, 1923.
[b] Classified as "automobiles" prior to 1921.
[c] Partial total due to classification, by some States, of trucks and commercial cars with other motor vehicles.
[d] Separate figures not available.

World oil-burning vessels of 500 gross tons and over, June 30, 1914, 1920–1923 [a]

[Exclusive of Army, Navy, Admiralty, and other Government vessels]

Year	Number	Gross tonnage
1914	501	1,721,747
1920	2,021	9,039,247
1921	2,848	13,374,652
1922	3,110	15,004,548
1923	3,348	16,478,104

[a] American documented seagoing merchant vessels, Dept. Commerce Bur. Navigation.

COMPARATIVE FUEL VALUE OF COAL, PETROLEUM, AND NATURAL GAS

The comparison of the fuel value of the coal, petroleum, and natural gas produced in the United States, as shown in the following table and in Figure 20, is based on revised estimates of the energy equivalents of the output of coal of all kinds, of petroleum, and of natural gas reported in Mineral Resources of the United States. These estimates have been made by F. G. Tryon for coal and for the coal equivalent of natural gas consumed for the years 1882–1905 and by the writer for natural gas for the years 1906–1923 and for petroleum.

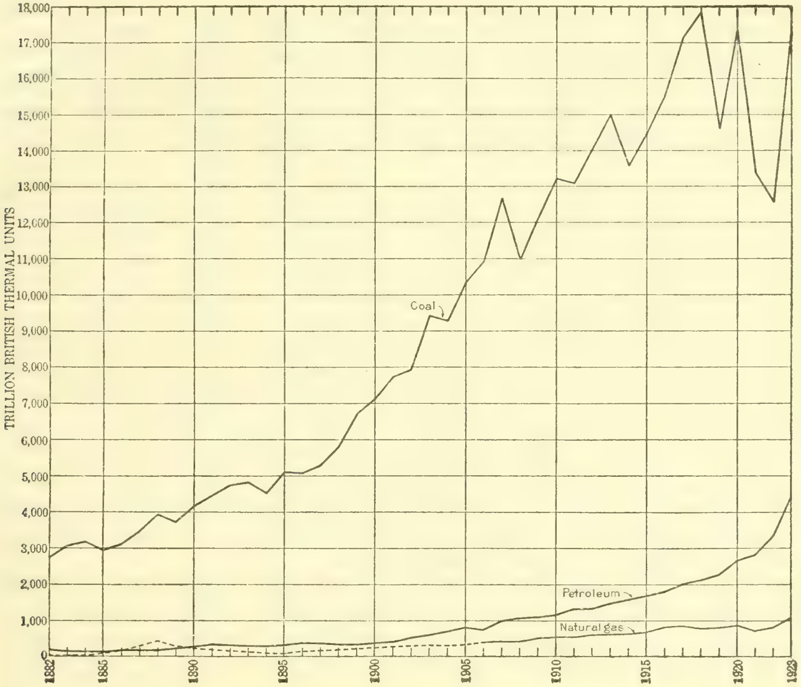

FIGURE 20.—Energy equivalent of coal, petroleum, and natural gas, 1882–1923

The conversion factors used in compiling the table assume that the weighted average thermal value per short ton of all bituminous coal produced in the United States equals 26,200,000 British thermal units; per short ton of Pennsylvania anthracite, 27,200,000 British thermal units; per barrel of petroleum, 6,000,000 British thermal units; and per cubic foot of natural gas, 1,075 British thermal units.

The table and diagram emphasize the dominating position of coal and the increasing importance in recent years of the hydrocarbons. Of the total energy supplied by mineral fuels in 1923, coal yielded 76 per cent, petroleum 19 per cent, and natural gas 5 per cent, whereas in 1913 coal yielded 88 per cent of the total, petroleum 9 per cent, and gas 3 per cent.

The fluctuating coal curve and the relatively smooth curves for petroleum and natural gas reflect the differences attending the production of these commodities. The fluctuations in the production of coal are in general accord with the major fluctuations in business activity, in which periods of prosperity, depression, and revival follow one another, modified by the effects of strikes and wage agreements. The production of petroleum, on the other hand, has been practically independent of general business conditions, and its output has not only kept pace with the rapidly growing demand for petroleum products, especially since the introduction of the internal-combustion engine, but at times, as during 1923, the new supply has been considerably in excess of the demand.

A noteworthy feature of the coal curve is the change in rate of output of coal in pre-war and postwar years. For many years prior to 1918 the growth was fairly uniform, but since 1918 the rate of change in production has been considerably less. Since the war the rate of coal production has slowed down, and in no year since 1918 has the output of coal reached the record attained in that year. The production of petroleum, on the other hand, has with minor exceptions constantly increased, and the output in 1923 was more than double that of 1918.

Competition between coal and oil in the last few years, especially during the period of oversupply of oil, has been accelerated by the low price of crude petroleum and its products. The only available data showing details of consumption of oil, both crude and refined, for fuel are those given in the tables on pages 407 and 408 and in volumes 8 and 11 of the Fourteenth Census, published in 1922 and 1923, showing the consumption by certain industries in 1919. A rough indication of the total quantity of crude petroleum consumed for fuel in the United States, however, is afforded by the difference between the total domestic consumption of crude petroleum, indicated by production plus imports minus exports plus stocks, including crude oil at refineries, at the beginning of the period minus stocks at the end of the period, and the quantity of crude oil run to refinery stills, although this difference includes also the unmeasured item of losses between the wells and the points of consumption.

An estimate of the crude petroleum and gas and fuel oils used for fuel during the years 1918 to 1923, together with the indicated equivalent of coal displaced, determined on a basis of thermal units, is given in the following table:

Indicated domestic consumption of crude petroleum and gas and fuel oils for fuel 1918–1923

[Millions of barrels]

	1918	1919	1920	1921	1922	1923
Indicated domestic consumption of crude petroleum	408	423	522	521	585	715
Runs of crude oil to refinery stills (Bureau of Mines)	326	362	434	443	501	581
Indicated other consumption of crude petroleum, chiefly for fuel (including losses)	82	61	88	78	84	134
Indicated consumption of gas and fuel oils (Bureau of Mines)	143	164	186	196	240	261
Consumption of crude petroleum and gas and fuel oils for fuel	225	225	274	274	324	395
Energy equivalent (trillions of British thermal units)	1,379	1,383	1,681	1,683	1,992	2,422
Approximate equivalent of coal (millions of short tons)	53	53	64	64	76	92
Percentage of annual production of coal in the United States	8	10	10	13	16	14

Coal, petroleum, and natural gas produced in the United States, from the date of earliest record to 1923

Year	Coal (bituminous and anthracite)			Petroleum			Natural gas		
	Millions of short tons	Value (millions of dollars)	Energy equivalent (trillions of British thermal units)	Millions of barrels	Value (millions of dollars)	Energy equivalent (trillions of British thermal units)	Billions of cubic feet	Value millions of dollars	Energy equivalent (trillions of British thermal units) [a]
Prior to 1882	1,101	(b)	29,800	186	356	1,114	(b)	----------	----------
1882	104	147	2,748	30	24	182	(b)	0.2	4
1883	116	159	3,070	23	26	141	(b)	.5	8
1884	120	144	3,185	24	21	145	(b)	1	25
1885	111	159	2,951	22	19	131	(b)	5	82
1886	114	155	3,017	28	20	168	(b)	10	169
1887	131	183	3,465	28	19	170	(b)	16	259
1888	149	191	3,942	28	18	166	(b)	23	368
1889	141	160	3,746	35	27	211	(b)	21	268
1890	158	177	4,180	46	35	275	(b)	19	257
1891	169	191	4,467	54	31	326	(b)	16	197
1892	179	208	4,751	51	26	303	(b)	15	170
1893	182	208	4,832	48	29	291	(b)	14	160
1894	171	186	4,525	49	36	296	(b)	14	155
1895	193	198	5,118	53	58	317	(b)	13	147
1896	192	197	5,084	61	59	366	(b)	13	151
1897	200	199	5,299	60	41	363	(b)	14	160
1898	220	208	5,817	55	44	332	(b)	15	186
1899	254	256	6,708	57	65	342	(b)	20	240
1900	270	307	7,123	64	76	382	(b)	24	254
1901	293	349	7,752	69	66	416	(b)	27	283
1902	302	367	7,943	89	71	533	(b)	31	301
1903	357	504	9,437	100	95	603	(b)	36	320
1904	352	444	9,291	117	101	702	(b)	38	333
1905	393	477	10,367	135	84	808	(b)	42	377
1906	414	513	10,922	126	92	759	389	47	418
1907	480	615	12,671	166	120	997	407	54	437
1908	416	532	10,978	179	129	1,071	402	55	432
1909	461	555	12,154	183	128	1,099	481	63	517
1910	502	630	13,226	210	128	1,257	509	71	547
1911	496	627	13,095	220	134	1,323	513	75	551
1912	534	696	14,087	223	164	1,338	562	85	604
1913	570	760	15,025	248	237	1,491	582	88	626
1914	514	681	13,545	266	214	1,595	592	94	636
1915	532	687	14,017	281	179	1,687	629	101	676
1916	590	867	15,548	301	331	1,805	753	120	810
1917	651	1,533	17,166	335	523	2,012	795	142	855
1918	678	1,828	17,868	356	704	2,136	721	154	775
1919	554	1,526	14,602	378	760	2,270	746	161	802
1920	658	2,564	17,336	443	1,361	2,658	798	196	858
1921	506	1,652	13,358	472	815	2,833	662	175	712
1922	477	1,549	12,551	558	895	3,345	763	222	820
1923	658	2,021	17,330	732	978	4,394	1,008	240	1,084

[a] Energy equivalent of natural gas for years 1882-1905 based on estimated quantity of coal displaced, calculated by F. G. Tryon.
[b] Not available.

PRICES

The figures given in the following table for the States east of California were compiled from reports to the Geological Survey of actual purchases by purchasing companies and include premiums. The figures for California were obtained from the California State Mining Bureau. In 1923 the average price, by States, ranged from 69 cents a barrel in Arkansas to $3.33 in Pennsylvania.

The general price trend was downward, and in December prices reached a low ebb. For most grades prices fell to as low a level in 1923 as they did in 1921, during the period of postwar deflation. In the first few months of the year, elsewhere than in California, there was an upward movement in prices apparently influenced by the temporary slackening in the rate of increasing supply (fig. 19); but with the rapidly rising production and the growing accumulation of stocks prices began to fall. In California there was not even a temporary rise. The price of heavy crude, below 20° (0.934) remained at 60 cents a barrel throughout the year, but there were a number of drops in the price of light oil—for instance, the price of 35° and lighter oil, which on January 1, 1923, was $1.95 a barrel, was reduced three times during the year and on October 9 was 76 cents.

As illustrative of these changes during 1923, the variations in posted prices of Pennsylvania and Mid-Continent grades may be noted. The year began with the posted price of $3.25 a barrel for Pennsylvania grade crude petroleum. During January there were three successive increases of 10 cents a barrel. On February 1 the Joseph Seep Purchasing Agency of the South Penn Oil Co. posted two sets of prices for Pennsylvania grade crude petroleum, Pennsylvania grade oil in the New York Transit Co.'s lines and Bradford district oil in the National Transit Co.'s lines bringing a higher price than Pennsylvania grade oil from the rest of Pennsylvania, Ohio, and West Virginia, the difference for the greater part of the year being 25 cents a barrel. During February there were three advances in price, bringing oil from the Bradford district up to $4.25 a barrel and other Pennsylvania grade crude to $4. These prices held until April 11, when the price was reduced 25 cents a barrel, after which there were six successive reductions until on November 13 the prices were respectively $2.60 and $2.35 a barrel. In December prices rose three times, and the year closed with prices of $3.25 and $3 a barrel.

The posted price of Oklahoma-Kansas and north Texas crude oil, ranging between 33° and 34.9°, at the beginning of the year was $1.25 a barrel. There were six successive increases in price of 10 cents each, to February 17. On April 23 the price was reduced to $1.75. There were three more drops in price of 10 cents a barrel each to May 12. On September 19 oil between 33° and 39.9° was reduced to $1.30 a barrel, and on November 8 to $1, a level as low as that reached in the summer of 1921, where it remained for the rest of the year.

Average price per barrel paid for crude petroleum at the wells, 1922–1923, by States

[Based on actual purchases, including premiums]

State	Average price per barrel at the well		State	Average price per barrel at the well	
	1922	1923		1922	1923
Arkansas	$1.61	$0.69	Ohio:		
California [a]	1.25	.92	Central and eastern	$2.70	$2.57
Colorado	1.18	1.19	Northwestern	2.25	2.02
Illinois	2.06	1.87	Total Ohio	2.56	2.41
Indiana:			Oklahoma	1.73	1.74
Southwestern	2.04	1.82	Pennsylvania	3.21	3.33
Northeastern	2.08	1.84	Tennessee	1.73	1.75
Total Indiana	2.05	1.82	Texas:		
Kansas	1.77	1.63	Coastal	1.19	1.39
Kentucky	1.98	1.97	Rest of State	1.76	1.50
Louisiana:			Total Texas	1.59	1.48
Coastal	1.25	1.36	West Virginia	3.26	3.27
Northern	1.52	1.48	Wyoming	1.27	1.09
Total Louisiana	1.50	1.47			
Montana	1.65	1.47	United States	1.61	1.34
New York	3.14	3.31			

[a] California State Mining Bureau.

WELLS

The following table, showing the approximate number of producing oil wells on December 31, 1922 and 1923, was compiled from reports of companies that operate gathering lines, supplemented, for the few small companies that do not maintain lists of wells with which their lines are connected, by estimates based on reports of producers with whose wells those lines are connected. Prior to 1920 the enumeration of producing oil wells published by the Geological Survey was based on reports of producers, and the results are not strictly comparable with the recent compilations.

Approximate number of producing oil wells in the United States December 31, 1922 and 1923

State	1922		1923	
	Approximate number of wells	Average production per well per day (barrels)	Approximate number of wells	Average production per well per day (barrels)
Arkansas	[a] 964	54.6	1,970	46.0
California	[b] 8,916	55.3	[b] 9,396	74.9
Colorado	75	3.2	60	3.5
Illinois	16,725	1.4	16,674	1.3
Indiana:				
Southwestern	1,050	2.1	1,050	1.8
Northeastern	1,500	.4	1,250	.5
Total Indiana	2,550	1.1	2,300	1.1
Kansas	17,900	4.4	17,750	4.2
Kentucky	10,600	2.1	11,700	1.7
Louisiana:				
Coastal	130	43.7	130	48.1
Northern	3,370	22.9	3,500	14.6
Total Louisiana	3,500	23.6	3,630	15.8
Montana	150	52.0	280	20.5
New York	14,300	.2	14,640	.3
Ohio:				
Central and eastern	20,300	.6	20,650	.6
Northwestern	19,000	.3	18,900	.3
Total Ohio	39,300	.5	39,550	.5
Oklahoma	57,500	7.5	57,500	6.9
Pennsylvania	75,000	.3	74,000	.3
Texas:				
Coastal	2,200	44.5	2,270	32.1
Rest of State	13,250	14.2	15,980	17.4
Total Texas	15,450	18.5	18,250	19.3
West Virginia	20,200	.9	20,100	.8
Wyoming	1,750	53.6	2,300	59.7
Grand total	284,880	5.7	290,100	6.6

[a] Bureau of Mines.

[b] American Petroleum Institute; does not include wells temporarily shut in. Total number of oil wells in California in 1923 reported by State Mining Bureau as 10,332 (Mining in California, July, 1924, p. 338).

Although there are more than 290,000 petroleum-producing wells in the United States, the greater part of the production is obtained from a relatively small number of wells, principally from those in the larger new pools. Data are not available for many pools, but the following table indicates general conditions. In 1923 the 5,100 wells in the eight major pools listed produced 340 million barrels of oil—that is, approximately 1.8 per cent of the total number of wells in the United States yielded 46 per cent of the total production.

Number of wells and petroleum produced in eight of the larger pools in 1923

Pool	Estimated number of producing wells, December, 1923	Production for the year (millions of barrels)
California:		
Santa Fe Springs	300	81.5
Long Beach	330	67.9
Huntington Beach	260	33.8
Oklahoma:		
Burbank	1,100	33.8
Tonkawa	600	27.0
Wyoming: Salt Creek	950	35.8
Texas: Powell	560	30.6
Arkansas: Smackover	1,000	30.0
	5,100	340.4

There is a general parallelism between the price curve for crude petroleum and the curve showing the number of oil wells completed (fig. 21), illustrating that in times of high prices there is greater drilling activity; but there is little accord between the daily average production and the number of oil wells completed, because large production may come from a relatively small number of new wells.

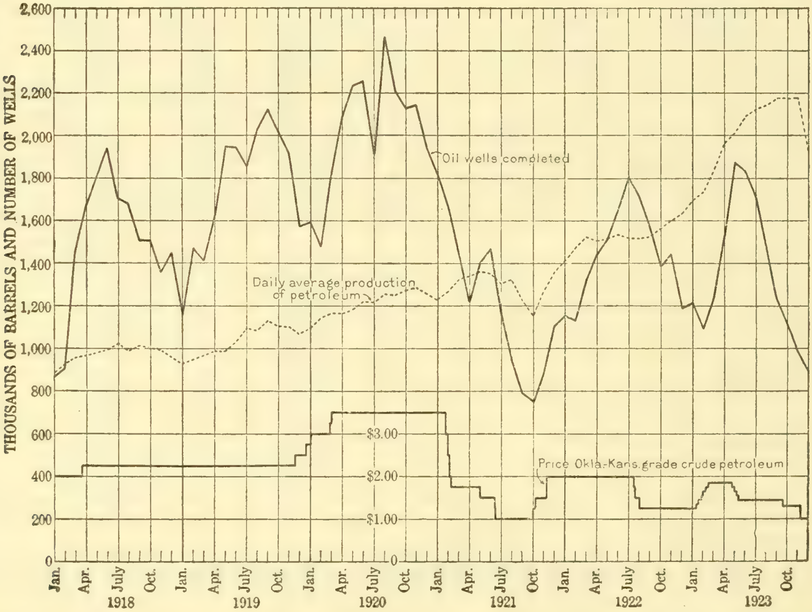

FIGURE 21.—Oil wells completed in the United States, price of Oklahoma-Kansas grade crude petroleum, and daily average production of petroleum, by months, 1918–1923

Reports of drilling activity showing wells put down for oil and gas, including oil wells, gas wells, and dry holes, have been published monthly for many years by the Oil and Gas Journal, and the results have been summarized in the Geological Survey's annual statistical statements. In 1923 the number of wells reported to have been drilled in search of oil and gas in the United States (exclusive of gas wells in California, for which figures are not available) was 24,438, which was less by 251 than the number reported in 1922. Of the total number drilled 66 per cent were oil wells, 10 per cent gas wells, and 24 per cent dry holes.

In 1923, as contrasted with 1922, increased drilling was reported in only five States—Arkansas, Texas, West Virginia, Montana, and California—and decreased drilling activity is recorded for the rest, Louisiana leading in this respect, 538 fewer wells having been drilled in that State than in the previous year. The greatest drilling activity was in Oklahoma, where 5,833 completions were recorded; then followed, in the order named, Texas, Pennsylvania and New York (combined), Ohio, Kentucky, Arkansas, Kansas, and West Virginia, in each of which more than 1,000 wells were sunk in search of oil and gas.

In the estimated average initial daily capacity of the oil wells drilled California led all the States with 1,404 barrels. Texas ranked second, with 656 barrels, and Arkansas third, with 615 barrels. Pennsylvania and New York (combined) were at the foot of the list, showing only 4 barrels.

Summary of wells drilled in the United States, 1914–1923 [a]

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Wells completed:										
Oil	16,668	9,154	18,777	16,590	17,845	21,052	24,273	14,666	17,333	16,206
Gas	2,327	2,022	1,803	1,966	2,229	2,135	2,274	2,111	2,024	2,349
Dry	4,142	2,981	4,039	4,851	5,613	5,986	7,364	5,160	5,332	5,883
	23,137	14,157	24,619	23,407	25,687	29,173	33,911	21,937	24,689	24,438

[a] California dry gas wells and dry holes not reported.

Wells drilled in the United States, 1922 and 1923, by months [a]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1922													
Oil	1,157	1,131	1,327	1,445	1,519	1,654	1,804	1,712	1,567	1,384	1,445	1,188	17,333
Gas	148	149	112	117	127	133	143	210	234	189	237	225	2,024
Dry	352	351	363	429	408	432	483	547	503	480	510	474	5,332
	1,657	1,631	1,802	1,991	2,054	2,219	2,430	2,469	2,304	2,053	2,192	1,887	24,689
1923													
Oil	1,215	1,093	1,239	1,525	1,875	1,836	1,717	1,469	1,240	1,114	989	894	16,206
Gas	236	165	168	207	171	181	209	216	181	185	213	217	2,349
Dry	505	455	482	505	572	566	619	605	466	401	359	348	5,883
	1,956	1,713	1,889	2,237	2,618	2,583	2,545	2,290	1,887	1,700	1,561	1,459	24,438

[a] California dry gas wells and dry holes not reported

Wells drilled for oil and gas in the United States, 1923, by States and counties or districts [a]

	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
Arkansas:					
Nevada County	9	3	14	26	146
Smackover district (Ouachita County)	502	40	58	600	624
Stephens district (Columbia and Ouachita counties)	143		7	150	42
Union County	692	36	119	847	731
Wildcat	8	6	32	46	830
	1,354	85	230	1,669	615
Total, 1922	593	46	91	730	729
California:[b]					
Coalinga	3			3	43
Compton	1			1	1,250
Coyote	5			5	144
Elk Hills	21			21	662
Fullerton	7			7	378
Huntington Beach	120			120	819
Kern River	1			1	5
Long Beach	250			250	1,824
Lost Hills-Belridge	1			1	10
McKittrick	1			1	25
Midway-Sunset	140			140	245
Montebello	5			5	151
Richfield	10			10	265
Santa Fe Springs	281			281	2,437
Santa Maria	3			3	37
Torrance	102			102	722
Ventura-Newhall	19			19	229
Wheeler Ridge	7			7	175
Whittier	3			3	505
	980	(b)	(b)	980	1,404
Total, 1922	837	(b)	(b)	837	(c)
Illinois:					
Clark	33	2	9	44	48
Crawford	26	3	16	45	6
Jackson	11	7	11	29	23
Lawrence	21		4	25	29
Marion	14		8	22	42
Monroe	10		2	12	6
Wabash	25		23	48	64
Other	8	6	21	35	19
	148	18	94	260	34
Total, 1922	252	2	87	341	23
Indiana:					
Northeastern—					
Adams	7		1	8	19
Jay	58	1	10	69	51
Randolph	5			5	29
Wells	5		1	6	12
Other	7		2	9	29
	82	1	14	97	43
Total, 1922	106	1	13	120	14
Southwestern—					
Gibson	14		14	28	31
Pike	19	1	6	26	21
Sullivan	3	1	10	14	3
Other	4	1	5	10	23
	40	3	35	78	23
Total, 1922	64	5	42	111	29
Total Indiana, 1923	122	4	49	175	36
1922	170	6	55	231	19

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[a] For States east of California, Oil and Gas Journal; for California, American Petroleum Institute.

[b] California dry gas wells and dry holes not reported.

[c] Not reported.

Wells drilled for oil and gas in the United States, 1923, by States and counties or districts—Continued

	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
Kansas:					
Butler	109	3	122	234	67
Chautauqua-Elk	23	18	32	73	61
Greenwood-Woodson	478	2	165	645	88
Marion	12	1	21	34	107
Miami-Douglas-Anderson-Franklin	43	5	34	82	54
Montgomery-Wilson	17	11	17	45	12
Neosho-Allen	29	1	12	42	19
Other	96	22	132	250	63
	807	63	535	1,405	76
Total, 1922	1,057	86	497	1,640	70
Kentucky:					
Allen	337	1	159	497	15
Daviess	21	----------	10	31	22
Johnson-Magoffin	343	45	10	398	16
Warren	293	4	95	392	22
Other	398	30	197	625	41
	1,392	80	471	1,943	24
Total, 1922	1,790	69	409	2,268	18
Louisiana:					
Gulf coast—					
Edgerley	15	----------	----------	15	160
Jennings	12	----------	6	18	142
Vinton	60	----------	20	80	98
Other	----------	----------	7	7	----------
	87	----------	33	120	114
Total, 1922	61	2	22	85	186
Northern—					
Bellevue	91	4	13	108	96
Caddo	56	4	23	83	117
Claiborne	35	1	20	56	72
De Soto and Red River	9	5	15	29	45
Elm Grove	10	6	10	26	34
Other	----------	123	56	179	----------
	201	143	137	481	93
Total, 1922	827	67	160	1,054	451
Total Louisiana, 1923	288	143	170	601	99
1922	888	69	182	1,139	437
Montana:					
Cat Creek	23	----------	7	30	125
Kevin-Sunburst	139	9	48	196	85
Other	----------	2	20	22	----------
	162	11	75	248	91
Total, 1922	53	4	27	84	207
Ohio:					
Central and eastern—					
Hocking	62	44	37	143	25
Holmes	41	41	33	115	34
Knox	138	48	26	212	7
Licking	70	4	9	83	16
Monroe	36	11	17	64	6
Muskingum	27	5	9	41	22
Noble	40	8	38	86	3
Perry	32	2	8	42	26
Washington	130	10	71	211	3
Wayne	18	84	49	151	18
Other	94	212	165	471	15
	688	469	462	1,619	13
Total, 1922	1,046	482	546	2,074	10

Wells drilled for oil and gas in the United States, 1923, by States and counties or districts—Continued

	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
Ohio—Continued.					
Northwestern—					
Allen	49	1	4	54	16
Auglaize	32		6	38	19
Darke	104		11	115	24
Hancock	88		5	93	23
Lucas	6		1	7	24
Mercer	82		19	101	15
Ottawa	37	1		38	9
Sandusky	27		2	29	8
Seneca	17		12	29	90
Van Wert	26	3	3	32	19
Wood	127	5	10	142	25
Other	10	7	2	19	15
	605	17	75	697	22
Total, 1922	449	12	61	522	17
Total Ohio, 1923	1,293	486	537	2,316	17
1922	1,495	494	607	2,596	12
Oklahoma:					
Carter	297	38	45	380	190
Creek	582	53	310	945	320
Garfield-Noble	381	6	50	437	529
Kay	401	37	69	507	976
Muskogee-Wagoner	62	19	98	179	39
Nowata-Rogers	51	9	29	89	20
Okfuskee-Hughes-Seminole-McIntosh	161	88	219	468	327
Okmulgee	259	67	236	562	112
Osage	722	60	179	961	409
Pawnee	117	18	55	190	64
Payne	23	10	24	57	72
Stephens-Cotton	183	53	122	358	45
Tulsa	109	39	104	252	61
Washington	31	2	23	56	12
Other	136	88	168	392	278
	3,515	587	1,731	5,833	364
Total, 1922	4,149	571	1,428	6,148	287
Pennsylvania and New York:					
Allegany	265	4	3	272	3
Bradford district	842	3	8	853	3
Butler-Armstrong	115	30	55	200	3
Middle Field	221	11	27	259	8
Venango-Clarion	421	53	42	516	2
Southwestern Pennsylvania—					
Allegheny County	50	45	25	120	11
Beaver County	17	4	22	43	2
Greene County	18	80	21	119	13
Washington County	10	13	17	40	13
	1,959	243	220	2,422	4
Total, 1922	2,262	270	274	2,806	6
Texas:					
Coastal—					
Barbers Hill	16		18	34	388
Batson	26		11	37	62
Big Creek	3		7	10	550
Big Hill	2			2	1,288
Blue Ridge	8		3	11	826
Damon Mound	29		18	47	139
Goose Creek	114		48	162	237
Hull	127		65	192	776
Humble	54		20	74	146
Markham			7	7	
Orange	138		43	181	755
Pierce Junction	14		16	30	430
Saratoga	6		3	9	45
Sourlake	40		16	56	171
Spindletop	14		7	21	38
West Columbia	44		21	65	1,411
Other	3		71	74	1,175
	638		374	1,012	532
Total, 1922	607	32	506	1,145	870

Wells drilled for oil and gas in the United States, 1923, by States and counties or districts—Continued

	Oil	Gas	Dry	Total	Estimated average initial daily production per well (barrels)
Texas—Continued.					
Rest of State—					
Archer County	539	----------	229	768	122
Burkburnett	140	----------	54	194	125
Eastland County	152	26	71	249	91
Limestone County	36	2	40	78	72
Luling	57	----------	8	65	990
Milam County	76	----------	13	89	12
Navarro County	599	1	64	664	2, 699
Shackelford County	248	----------	32	280	48
Somerset	99	----------	2	101	9
Stephens County	144	14	48	206	236
Webb and Zapata counties	160	----------	8	168	128
Wichita County	320	----------	201	521	91
Young County	70	6	83	159	109
Other	111	35	226	372	65
	2, 751	84	1, 079	3, 914	685
Total, 1922	2, 290	81	906	3, 277	440
Total Texas, 1923	3, 389	84	1, 453	4, 926	656
1922	2, 897	113	1, 412	4, 422	530
West Virginia:					
Braxton	2	8	1	11	20
Doddridge	40	38	17	95	11
Gilmer	24	82	21	127	15
Kanawha	10	34	7	51	10
Lincoln	14	4	----------	18	4
Marion	10	11	9	30	9
Marshall	14	17	10	41	10
Pleasants	38	13	26	77	5
Ritchie	72	108	41	221	7
Roane	16	2	11	29	10
Wetzel and Tyler	45	55	22	122	15
Wirt	12	1	8	21	5
Wood	32	----------	11	43	3
Other	75	130	38	243	15
	404	503	222	1, 129	10
Total, 1922	453	274	216	943	11
Wyoming:					
Big Horn Basin	4	7	5	16	20
Big Muddy	9	----------	1	10	190
Fremont County	3	1	3	7	150
Lance Creek	4	1	2	7	775
Lost Soldier and Carbon County	7	6	4	17	1, 750
Mule Creek	3	----------	----------	3	133
Natrona County:					
Salt Creek-Teapot	308	11	6	325	338
Other	9	4	7	20	234
Osage	12	----------	1	13	32
Rock Creek	11	----------	8	19	168
Other	4	7	3	14	56
	374	37	40	451	338
Total, 1922	421	19	32	472	461
Other States,[d] 1923	19	5	56	80	----------
1922	16	1	15	32	----------
United States, 1923	16, 206	[b] 2, 349	[b] 5, 883	[b] 24, 438	----------
1922	17, 333	[b] 2, 024	[b] 5, 332	[b] 24, 689	----------

[b] California dry gas wells and dry holes not reported.

[d] 1922: Tennessee; 1923: Colorado, New Mexico, Tennessee, and Utah.

ACREAGE

In the accompanying table the estimate of developed petroleum acreage in the United States in 1923 for the States east of California is based on a canvass of representative producers, who reported to the Geological Survey data, by fields and districts, from which figures indicating approximate average developed acreage per well for the major fields were obtained. The estimated total number of acres was determined by multiplying these factors by the total number of producing wells as reported by companies that operate gathering lines. For California acreage has been determined in detail by the State Mining Bureau, which reports both developed[13] and proved[14] acreage, but in the absence of detailed surveys, similar data for the rest of the country are not available.

Estimated developed petroleum acreage, by major fields, 1923

	Acres
Appalachian	2, 000, 000
Lima-Indiana	300, 000
Illinois-Southwestern Indiana	160, 000
Mid-Continent	1, 600, 000
Gulf coast	25, 000
Rocky Mountain	55, 000
California	60, 000
	4, 200, 000

OIL PIPE-LINE MILEAGE

The following table was compiled in the spring of 1924 from reports to the Geological Survey from companies operating oil pipe lines. About 14½ million barrels of oil is required to keep the lines filled.

Oil pipe-line mileage and capacity, by States

State	Trunk lines		Gathering lines		Total	
	Miles	Barrels	Miles	Barrels	Miles	Barrels
Arkansas	591	186, 400	645	75, 300	1, 236	261, 700
California	3, 078	988, 900	1, 461	207, 600	4, 539	1, 196, 500
Colorado			29	1, 100	29	1, 100
Illinois	1, 937	685, 400	1, 218	141, 900	3, 155	827, 300
Indiana	1, 469	514, 100	503	29, 900	1, 972	544, 000
Iowa	77	37, 700			77	37, 700
Kansas	2, 542	801, 400	2, 762	214, 300	5, 304	1, 015, 700
Kentucky	592	50, 100	1, 383	48, 600	1, 975	98, 700
Louisiana	1, 751	647, 500	806	77, 300	2, 557	724, 800
Maryland	36	4, 700			36	4, 700
Michigan	138	26, 200			138	26, 200
Missouri	2, 485	993, 400			2, 485	993, 400
Montana	93	9, 100	20	400	113	9, 500
Nebraska	377	248, 700			377	248, 700
New Jersey	476	116, 900			476	116, 900
New York	1, 192	217, 300	687	30, 200	1, 879	247, 500
Ohio	2, 623	768, 000	6, 192	278, 800	8, 815	1, 046, 800
Oklahoma	7, 695	1, 734, 400	9, 689	673, 400	17, 384	2, 407, 800
Pennsylvania	5, 274	1, 100, 600	6, 094	201, 300	11, 368	1, 301, 900
Tennessee			5	100	5	100
Texas	7, 379	2, 136, 000	4, 665	504, 100	12, 044	2, 640, 100
West Virginia	419	71, 100	4, 957	313, 900	5, 376	385, 000
Wyoming	1, 273	291, 000	219	20, 400	1, 492	311, 400
	41, 497	11, 628, 900	41, 335	2, 818, 600	82, 832	14, 447, 500

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[13] California Oil Fields, August, 1923, p. 22.

[14] Mining in California, July, 1924, p 337.

SPECIFIC GRAVITY OF CRUDE PETROLEUM

The estimated average specific gravity of the crude petroleum produced in certain fields and districts, as reported by pipe-line and producing companies, is given in the accompanying table. The equivalents of "degrees A. P. I." in decimals representing specific gravity are taken from "National standard petroleum oil tables" (Circular 154 of the Bureau of Standards). These tables, published in 1924, are the outcome of an agreement among the American Petroleum Institute, the United States Bureau of Mines, and the United States Bureau of Standards to remove the confusion that has existed in the petroleum industry by reason of the use of two so-called Baumé scales for light liquids, one based on the modulus 140 and the other on the modulus 141.5. It has been recommended that only the scale based on the modulus 141.5 be used in the petroleum industry and that it be known as the A. P. I. scale.

Estimated average specific gravity of crude petroleum by major fields (weighted for production)

Field	Degrees A. P. I.	Specific gravity
Appalachian	41.0	0.8203
Lima-Indiana	36.0	.8448
Illinois-southwestern Indiana	32.5	.8628
Mid-Continent	35.0	.8498
Gulf coast	22.5	.9188
Rocky Mountain	37.5	.8373
California	26.5	.8956
United States	32.0	.8654

Estimated average specific gravity of crude petroleum from certain fields, 1923

[From reports of pipe-line and producing companies]

District or grade	Degrees A. P. I.	Specific gravity
Alaska: Katalla	44.0	0.806
Arkansas:		
El Dorado	34.0	.855
Irma	14.2	.971
Smackover, light (range 24–29)	25.0	.904
Smackover, heavy (range 16–23.9)	20.0	.934
Stephens	31.0	.871
California:		
Coalinga	18.9	.941
Coyote	24.3	.908
Dominguez	32.4	.863
Elk Hills	22.5	.919
Huntington Beach	25.6	.901
Kern River	14.0	.973
Long Beach	25.8	.900
Los Angeles	14.8	.967
Lost Hills-Belridge	25.5	.901
McKittrick	14.8	.967
Midway-Sunset	21.7	.924
Montebello	23.2	.915
Richfield	22.7	.918
Santa Fe Springs	33.0	.860
Santa Maria	16.9	.954
Sargent	16.0	.959
Summerland	13.0	.979
Torrance	20.7	.930
Ventura	30.2	.875
Wheeler Ridge	25.3	.902
Whittier	19.1	.940
Colorado:		
Florence	29.1	0.881
Moffat	41.0	.820
Rangely	43.5	.809
Illinois:		
"Illinois"	33.0	.860
Plymouth	34.2	.854
Waterloo	30.0	.876
Indiana:		
Northeastern ("Indiana")	35.5	.847
Southwestern ("Princeton")	33.0	.860
Kansas:		
Augusta	34.0	.855
Eldorado	36.0	.845
Fox-Bush	39.0	.830
Iola	19.0	.940
Madison	41.0	.820
Moran	28.0	.887
Peabody-Elbing	35.0	.850
Rainbow	39.0	.830
Teeter	39.5	.828
Virgil	38.0	.835
Kentucky:		
Ragland	25.2	.903
Ravenna	39.0	.830
Rodemer	29.0	.882
Scottsville	35.0	.850
Somerset (light)	39.0	.830
Somerset (medium)	35.5	.847
Warren County	36.0	.845

Estimated average specific gravity of crude petroleum from certain fields, 1923—Continued

District or grade	Degrees A. P. I	Specific gravity
Louisiana:		
Bellevue	19.0	0.940
Bull Bayou	39.5	.828
Caddo (light)	39.5	.828
Caddo (heavy)	23.0	.916
Cotton Valley	29.0	.882
De Soto	40.5	.823
Edgerley	21.0	.928
Elm Grove	30.5	.874
Haynesville	35.0	.850
Homer	36.0	.845
Jennings	24.5	.907
Vinton	20.0	.934
Montana:		
Cat Creek	49.0	.784
Elk Basin	43.0	.811
Kevin-Sunburst	32.0	.865
Soap Creek	19.7	.936
New Mexico:		
Artesia	37.0	.840
Hogback	56.0	.755
New York	42.0	.816
Ohio:		
Cleveland	38.2	.834
Corning	42.0	.816
Lima	36.3	.843
"Pennsylvania" (Macksburg)	42.5	.812
Wooster	38.1	.834
Oklahoma:		
Billings	41.0	.820
Blackwell	39.2	.829
Bristow	33.0	.860
Burbank	38.0	.835
Cement	31.0	.871
Cleveland	37.5	.837
Cromwell	37.0	.840
Cushing	39.0	.830
Duncan	36.0	.845
Fox	21.7	.924
Garber	43.0	.811
Glenn	34.0	.855
Healdton	29.5	.879
Hewitt	34.0	.855
Keywest	41.5	.818
Lyons	39.5	.828
Ponca	40.0	.825
Tonkawa	42.0	.816
Walters	31.0	.871
Wewoka	37.5	.837
Wheeler	21.7	.924
Pennsylvania:		
Franklin	29.5	.879
"Pennsylvania"	42.0	.816
Tennessee	39.0	.830
Texas:		
Batson	20.6	0.930
Big Creek	24.0	.910
Big Lake	37.6	.837
Breckenridge	38.0	.835
Burkburnett	38.0	.835
Calliham	18.0	.947
Carson County	36.0	.845
Currie	42.0	.816
Damon Mound	21.5	.925
Electra	40.0	.825
Goose Creek	24.0	.910
Holliday	39.0	.830
Hull	22.5	.919
Humble	23.0	.916
Luling	28.0	.887
Mexia	36.5	.842
Minerva	38.0	.835
Mirando	20.0	.934
Orange	22.7	.918
Pierce Junction	23.5	.913
Pioneer	41.5	.818
Powell	37.5	.837
Ranger	37.5	.837
Richland	39.0	.830
Saratoga	19.0	.940
Somerset	33.0	.860
Sourlake	21.7	.924
Spindletop	22.5	.919
Swastika	40.0	.825
Westbrook	25.0	.904
West Columbia	22.8	.917
West Virginia:		
Cabell	39.3	.829
Cabin Creek	48.0	.788
Kellys Creek	45.0	.802
"Pennsylvania"	43.0	.811
Volcano	29.0	.882
Wyoming:		
Big Muddy	33.0	.860
Byron	41.0	.820
Elk Basin	43.0	.811
Grass Creek (light)	45.0	.802
Grass Creek (heavy)	21.0	.928
Greybull-Torchlight	45.0	.802
Hamilton Dome	25.0	.904
Lance Creek	42.0	.816
Lander	23.0	.916
Lost Soldier	31.5	.868
Notches	23.0	.916
Pilot Butte	33.0	.860
Poison Spider	15.0	.966
Rex Lake	32.3	.864
Rock Creek	37.4	.838
Salt Creek	37.0	.840
Teapot	36.4	.843

PRODUCTION OF PETROLEUM AND ROYALTIES UNDER FEDERAL CONTROL

The following tables have been compiled from data received by the Bureau of Mines and by the Office of Indian Affairs:

Crude petroleum produced on Government lands in 1922–1923, under the operation of the leasing act of February 25, 1920

[Reported by the U. S. Bureau of Mines]

State and land office	1922			1923		
	Production (barrels)	Royalty		Production (barrels)	Royalty	
		Barrels	Value		Barrels	Value
California:						
Los Angeles	1, 343, 049. 77	197, 437. 49	$297, 722. 99	1, 506, 453. 94	176, 281. 22	$183, 457. 61
Visalia, outside naval reserves	3, 209, 204. 64	520, 195. 90	501, 424. 19	2, 818, 166. 66	403, 523. 66	279, 972. 15
Visalia, inside naval reserves	7, 167, 643. 13	1, 842, 891. 83	2, 194, 214. 65	10, 290, 460. 51	2, 384, 667. 99	1, 939, 011. 11
	11, 719, 897. 54	2, 560, 525. 22	2, 993, 361. 83	14, 615, 081. 11	2, 964, 472. 87	2, 402, 440. 87
Colorado:						
Glenwood Springs	199. 00	39. 79	35. 85	1, 496. 05	299. 20	305. 74
Montana:						
Great Falls	------------	------------	------------	10, 467. 77	523. 39	534. 52
Lewistown	1, 962, 449. 80	109, 263. 85	243, 593. 18	1, 747, 279. 40	119, 887. 91	285, 868. 16
	1, 962, 449. 80	109, 263. 85	243, 593. 18	1, 757, 747. 17	120, 411. 30	286, 402. 68
Wyoming:						
Cheyenne	78, 339. 42	5, 770. 65	4, 235. 59	128, 284. 25	9, 875. 08	8, 230. 56
Douglas, outside naval reserves	14, 233, 952. 20	2, 964, 524. 61	3, 250, 956. 81	29, 896, 479. 09	6, 616, 050. 88	10, 687, 166. 43
Douglas, inside naval reserves	37, 243. 29	6, 894. 88	9, 604. 79	1, 136, 948. 28	177, 686. 93	270, 046. 53
Lander	135, 450. 56	15, 946. 87	16, 101. 80	397, 919. 75	50, 918. 20	73, 913. 55
Newcastle	34, 792. 82	3, 776. 36	6, 328. 27	67, 461. 88	8, 537. 19	13, 560. 53
	14, 519, 778. 29	2, 996, 913. 37	3, 287, 227. 26	31, 627, 093. 25	6, 863, 068. 28	11, 052, 917. 60
	28, 202, 324. 63	5, 666, 742. 23	6, 524, 218. 12	48, 001, 417. 58	9, 948, 251. 65	13, 742, 066. 89

Royalty receipts from production of oil and gas and bonuses paid for sale of leases on Indian reservations, fiscal years ending June 30, 1922–1923

[From Office of Indian Affairs]

Reservation	1922			1923		
	Oil and gas land leased during year (acres)	Receipts		Oil and gas land leased during year (acres)	Receipts	
		Bonus from sale of leases	Royalty from production		Bonus from sale of leases	Royalty from production
Five Civilized Tribes:						
Oil	130,415	$689,126	$2,247,739	197,540	$1,084,798	$3,155,454
Gas			148,880			133,226
Crow: Oil	47,757	4,371	----------	----------	----------	----------
Kiowa:						
Oil	7,390	27,797	25,000	13,238	----------	22,788
Gas			1,500			
Osage:						
Oil	102,353	22,101,250	8,542,990	47,711	15,671,404	13,048,878
Gas	----------	----------	692,702			1,023,664
Pawnee:						
Oil	8,099	13,839	32,915	4,352	45,856	123,489
Gas	----------	----------	----------			
Ponca and Otoe:						
Oil	57,284	105,420	58,689	10,067	25,594	63,983
Gas	----------	----------	2,152			
Seger: Oil	6,533	16,557	----------	----------	----------	----------
Shawnee:						
Oil	3,800	10,130	6,575	----------	24,956	7,869
Gas	----------	----------	----------			
Shoshone: Oil	3,120	2,840	8,000	5,560	13,051	6,394
	366,751	22,971,330	11,767,142	278,468	16,865,659	17,585,745

SUMMARY OF REFINERY STATISTICS

Refinery statistics compiled and published by the Bureau of Mines are summarized below. Contrasted with an increase of 106 per cent in the production of crude petroleum during the period 1918–1923 are the following gains in the output of the chief products of petroleum refineries: Kerosene, 29 per cent; lubricants, 30 per cent; gas and fuel oil, 65 per cent; gasoline, 112 per cent.

In 1923 the output of gasoline from petroleum refineries was 31 per cent of the crude oil run to stills, as contrasted with 26 per cent in 1918 and 13 per cent in 1914; the output of gas and fuel oil dropped from 53 per cent of the quantity of crude oil run to stills in 1918 to 49 per cent in 1923. The increased rate of production of gasoline is due primarily to increased use of cracking methods and also to the increased use of natural-gas gasoline for blending at petroleum refineries.

Refinery statistics, 1918–1923[a]

[Thousands of barrels of 42 U. S. gallons except as otherwise indicated]

	1918	1919	1920	1921	1922	1923
Crude oil (domestic and foreign) run to stills	326,025	361,520	433,915	443,363	500,706	581,238
Natural-gas gasoline run to stills or blended at refineries	2,451	2,957	3,153	2,517	3,662	5,487
Stocks of crude oil (domestic and foreign) at refineries at end of year	15,750	13,143	21,261	26,562	33,805	33,259
Gasoline:						
Produced	85,007	94,235	116,251	122,704	147,672	179,903
Imported	307	203	964	900	1,479	4,555
Exported [b]	13,545	9,098	15,637	13,134	14,156	20,741
Consumed	74,506	81,781	101,207	107,524	127,907	159,167
Stocks at refineries at end of year	7,079	10,638	11,009	13,955	21,043	25,593
Kerosene:						
Produced	43,461	55,753	55,240	46,313	54,913	55,927
Imported	([c])	([c])	([c])	([c])	[d] 3	7
Exported [b]	11,820	23,537	20,878	18,016	21,489	20,346
Consumed	34,442	33,188	33,082	29,537	34,855	35,536
Stocks at refineries at end of year	9,051	8,079	9,359	8,119	6,691	6,743
Gas and fuel oils:						
Produced	174,319	181,602	210,987	230,091	254,910	287,481
Imported	([c])	([c])	([c])	([c])	[d] 2,947	12,286
Exported [b]	29,637	16,487	22,080	22,676	18,479	33,372
Consumed	142,751	163,802	185,972	195,656	240,010	261,388
Stocks at refineries at end of year	15,690	17,003	19,938	31,697	31,065	36,072
Lubricants:						
Produced	20,035	20,161	24,938	20,896	23,304	26,128
Imported	([c])	([c])	([c])	([c])	[d] 43	29
Exported [b]	6,165	6,598	9,643	6,937	7,940	8,371
Consumed	13,823	13,600	14,742	12,046	15,529	17,618
Stocks at refineries at end of year	3,306	3,269	3,822	5,735	5,613	5,781
Wax (thousands of pounds):						
Produced	505,144	467,235	541,204	434,884	462,003	466,647
Stocks at refineries at end of year	199,658	222,462	195,368	207,563	204,891	164,706
Coke (short tons):						
Produced	559,663	603,459	576,613	604,465	707,064	672,526
Stocks at refineries at end of year	22,605	21,146	31,469	74,508	35,722	26,264
Asphalt (short tons):						
Produced	607,968	901,885	1,290,614	1,214,536	1,895,257	2,327,116
Stocks at refineries at end of year	76,858	73,449	81,097	98,330	119,648	114,670

[a] Compiled from Petroleum Refinery Statistics for 1923, Bureau of Mines.
[b] Including shipments to Alaska, Hawaii, and Porto Rico.
[c] No data available.
[d] October–December only.

SHALE OIL

Overproduction of petroleum and low prices have continued to retard commercial operations in oil shale. Nevertheless, 292,000 gallons of oil was reported to the Geological Survey as having been produced by distillation from shale at three plants in 1923—one at Elko, Nev., and two near Casmalia, Santa Barbara County, Calif. These three plants were also operated on a smaller scale in 1922. The operators of the plants in the vicinity of De Beque, Colo., from which 6,250 gallons was produced in 1921, have not since then reported any production.

Details concerning the operations of these plants are not yet available for publication, although general conditions in California[15] and Nevada[16] have been described. The shale oil produced in Nevada was extracted from typical oil shale—a shale which "does not contain oil that may be extracted by mechanical means but contains an abundance of partly bituminized organic matter that can be converted into oil by heating."[17] The shale oil produced in California, on the other hand, was obtained from an oil-saturated diatomaceous shale from which oil may be extracted by solvents.

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[15] Gore, F. D., Oil shale in Santa Barbara County, Calif.: Am. Assoc. Petroleum Geologists Bull., vol. 8, pp. 459–472, 1924.

[16] Winchester, D. E., Oil shale of the Rocky Mountain region: U. S. Geol. Survey Bull. 729, pp. 91–192, 1923. Kirkpatrick, S. K., Producing shale oil on a commercial basis: Chem. and Met. Eng., vol. 31, pp. 771–773, 1924.

Progress in research and experimental work was continued during 1923 in the laboratories of the Bureau of Mines, cooperating with the States of Colorado and Utah, in the laboratories of several universities, corporations, and private individuals, and at a number of plants. The proceedings of the National Oil Shale Conference in connection with the American Mining Congress at Milwaukee in September, 1923, in which the current status of the industry was reviewed, are given in full in the Quarterly of the Colorado School of Mines for October, 1923.

Oil produced from shale by distillation in the United States, 1923

State	Number of plants reported	Crude oil produced (gallons)	Average specific gravity of crude oil	Estimated average recovery of oil (gallons per ton of shale treated)
California	2	160, 000	0. 913 (17°)	30
Nevada	1	132, 000	. 920 (22.3°)	26

World's production of oil shale, 1919–1923, in metric tons [a]

Country	1919	1920	1921	1922	1923
Australia:					
New South Wales	25, 861	21, 341	33, 009	23, 844	1, 226
Tasmania	610	142	882	41	1, 119
Esthonia	9, 664	46, 111	95, 514	138, 922	183, 985
France	49, 127	69, 000	64, 693	61, 000	([b])
Italy	10, 563	16, 325	3, 030	5, 476	5, 662
Russia	4, 533	30, 366	19, 300	18, 500	24, 200
Spain	5, 527	([c])	([c])	([c])	([c])
Sweden	----------	----------	([d])	([d])	([d])
United Kingdom:					
England	620	1, 750	----------	----------	71
Scotland	2, 807, 615	2, 886, 455	1, 896, 860	2, 645, 790	2, 906, 475
United States	([b])	([b])	([b])	([b])	[e] 9, 300

[a] Figures obtained from official sources.
[b] Data not available.
[c] There is in operation in Puertollano a plant for the treatment of oil shale and impure coal to obtain oil, but no details of production are available.
[d] Data on production of oil shale not available; the following quantities of shale oil were extracted from alum shale: 1921, 328 metric tons; 1922, 353 tons; 1923, 158 tons.
[e] Estimated. Used in production of shale oil.

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[17] Winchester, D. E., op. cit., p. 8.

COKE AND BY-PRODUCTS

By F. G. Tryon and H. L. Bennit

INTRODUCTION

METHOD OF PRESENTATION

Two reasons have prompted the publication in skeletonized form of the Geological Survey's report on coke and by-products in 1923. One has been the pressure of other work devolving upon the Survey unit that collects the statistics of coal and coke. For six months the entire energies of the statistician in charge have been devoted to editing the reports of the United States Coal Commission and seeing them through the press. Time has therefore been lacking to prepare the usual analytical text and market review of the industry. The other reason for omitting the analysis has been the great detail in which the report for 1922 was developed. By presenting the data for 1923 in the same tabular form, the explanations given for 1922 may be made to serve both years. The reader of this report who desires further light on the meaning of the tables will therefore do well to consult the corresponding passages of the report for 1922.[1] To facilitate comparison of the two reports, the arrangement of matter adopted for 1922 has been closely adhered to. The tables have been grouped by subjects, as indicated by the center headings.

DEFINITIONS

The standard unit of measurement in the coke industry in the United States is the short or net ton of 2,000 pounds. Unless otherwise specified, this is the unit employed throughout this chapter.

In this report the term "coke" does not include breeze or the fine coke screenings, because operators in general, especially those in the beehive industry, do not regard this fine material as properly so classified. No effort has been made to define accurately the limitation as to size between coke and breeze. Each operator has followed his own regular practice in reporting his output of fine material to the Geological Survey. It is probably safe to say, however, that coke breeze and screenings correspond closely in size to the anthracite usually classified as steam sizes; in other words, they include the material smaller than pea coal.

For reasons explained in the following section, the statistics of by-product coke in this report cover the operations of all by-product coke ovens, including those installed and operated by public utilities engaged primarily in manufacturing gas for city supply.

The tables of the report classify the sales as between "furnace coke," "foundry coke," and "domestic and other coke." These terms are general trade designations referring to physical or chemical properties of the coke quite as much as to the precise uses to which the product is put. Not all foundry coke, for example, finds its way to foundrymen. In the beehive-coke trade furnace coke is commonly 48-hour coke, and foundry coke is supposed to be 72-hour coke, which commonly comes in larger, longer, and harder pieces than furnace coke and is selected with more care to prevent the loading of the soft pieces and black ends. To compensate for this extra work and for the heavier capital charges resulting from the longer coking time, foundry coke commonly sells at 50 cents to $1 a ton more. (See Table 44.) Under the actual conditions of the market the distinction in coking time is not always observed, and some so-called foundry coke is ordinary 48-hour furnace coke from which the soft pieces and black ends have been thrown out.

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[1] U. S. Geol. Survey Mineral Resources, 1922, pt. 2, pp. 671-799, 1925.

In the manufacture of by-product coke the universal practice of crushing the coal before coking and the facilities for screening and sizing the coke permit more precise definition of grades. In terms of size by-product furnace coke is run-of-oven coke from which the breeze and all small coke of less than say three-fourths inch in diameter have been removed. By-product foundry coke is a blocky coke whose maximum size is much greater than that of furnace coke and from which all sizes under 2½ to 3 inches are screened out. Domestic coke includes all sizes of approximately 3 inches and under, exclusive of breeze. It may result from the screening of foundry coke or even furnace coke, or where the principal demand is for domestic coke it may be obtained by crushing the larger fragments.

Knowing that some furnace coke and considerable foundry or domestic coke is sold for other than metallurgical use, the Geological Survey in 1923 added a question to its schedule asking for the quantity sold "for other industrial use." The replies, tabulated in Tables 35 and 36, are probably incomplete.

ACKNOWLEDGMENTS

This report is based upon statistical returns by the producers of coke, for whose generous and continuing assistance thanks are cordially extended. Special mention should be made of the courtesy of operators of by-product coke plants in supplying monthly returns of coke output. The railroads have furnished weekly reports of cars of beehive coke loaded, which have been indispensable in preparing the current estimates of production of beehive coke and bituminous coal. (See Tables 5 and 6.) For the statistics of imports and exports the Survey is indebted to the Bureau of Foreign and Domestic Commerce, from whose records they have been compiled by J. A. Dorsey. The statistics of world production of coke in Table 56 have been assembled by W. I. Whiteside. All the other tables have been compiled by the junior author under the direction of the senior author.

NEW FEATURES IN THE PRESENT REPORT

Certain innovations in the present report should be noted here. For the first time statistics are presented of the quantity of by-product coke loaded for shipment on each railroad and waterway (Tables 54 and 55, pp. 475-477). Like the corresponding tables for shipments of beehive coke, these figures are based not on records of the railroads but on reports from the producers of coke.

A change has been made in the form of reporting sales of coke. Operators have been requested to separate sales of furnace coke into "sales to affiliated corporations" and "merchant sales." Again, an inquiry as to the "sales for domestic and other use," as distinct from "furnace" and "foundry," has been subdivided to read "sales for domestic use" and "sales for industrial and other use," the last heading excluding, of course, blast furnace and foundry coke. The changes in the form of the figures resulting from these changes in the statistical schedule of inquiry will be clear from Tables 35 and 36 (pp. 458–463).

ACCOUNTING PRACTICES OF COKE OPERATORS THAT AFFECT THE STATISTICS

The term "value," as applied to coke in the reports of the Geological Survey, means the value at the ovens. For that part of the output that is sold the value is obviously the amount received for the coke f. o. b. ovens. But a considerable proportion of the coke produced in the United States is made in ovens operated by large corporations that not only mine the coal and make the coke but also operate blast furnaces and steel mills that consume the entire product of the ovens. Under such conditions the fixing of a value upon the coke and upon the coal consumed in making it is purely arbitrary. By some corporations the coke is charged to the furnace department at cost; by others a percentage of profit is added or the reported value is based on what the coke would cost if purchased.

In the statistics published by the Geological Survey the value assigned to that part of the output produced but not sold has not always been arrived at in the same way, and therefore the figures of total value of all coke produced are not strictly comparable from year to year. Prior to 1918 each operator was asked to place his own value on his entire production, including coke used at the plant but not sold. In 1918 and again in 1920 the value of this part of the product was estimated by the Geological Survey by assigning to the coke produced but not sold in each State a value per ton equal to the average receipts for the coke sold in the same State. In 1919 and again in 1921, 1922, and 1923 the Survey asked the operator to place his own value on the coke used but not sold. These changes in the form of inquiry must be borne in mind in considering Tables 3, 35, 36, and 40.

These differences in accounting practice also affect the relative proportions of the output reported as "sold" and as "used by producer." Between the blast furnaces, which are the largest users of coke, and the coke plants there exists a close business relation, which in many plants amounts to identity of ownership. Among such affiliated interests the line between sales and interdepartmental transfers is difficult to draw, and a large part of the furnace coke reported as sold actually goes to iron furnaces that are in some way connected with the coke companies. (See Tables 35 and 36.)

THE COKE-PRODUCING INDUSTRIES

SUMMARY

Coke is produced in the United States by a group of four industries, which are related in the sense that the product is to some extent interchangeable but which are sharply differentiated as to location, method, equipment, and organization. Besides that produced in the familiar beehive and by-product ovens, coke is obtained in the refining of petroleum, in the manufacture of coal gas, and in the refining of coal tar.

Petroleum coke may be dismissed with a few words. In refining crude oil there is often an ultimate residue in the form of a porous, carbonaceous mass. Its properties are much like those of coke made from coal, except that it is finer in texture, lacks the strength required for metallurgical coke, and is extraordinarily low in ash. The production of petroleum coke in recent years, according to statistics collected by the Bureau of Mines, has been as follows:

Petroleum coke produced and in stock in the United States, 1917–1923, in net tons[a]

Year	Production	Stock at end of year
1917	539, 366	7, 585
1918	559, 663	22, 605
1919	603, 459	21, 146
1920	576, 613	31, 469
1921	604, 465	74, 508
1922	707, 064	35, 722
1923	672, 526	26, 264

[a] Petroleum Refinery Statistics, Bureau of Mines.

In the coal-gas industry, as in petroleum refining, the coke obtained is a by-product. The process of carbonization is essentially the same as that in by-product ovens, though the type of oven is different. The coals used are selected for their yield in gas rather than for their coking qualities, and the coke formed is too soft for foundry or furnace use. It is, however, well adapted to the manufacture of water gas, a fact which has led to the common association of coal-gas and water-gas plants. Thus, out of 2,877,787 tons of gas-house coke produced in 1922, 51.8 per cent was used in making water gas, in heating retorts, or for boiler fuel about the plant where it was produced. The remainder, 1,387,658 tons, was sold, largely as domestic fuel, for $12,032,244.

Neither petroleum coke nor gas-house coke is adapted for metallurgical purposes, the use which consumes the great bulk of all the coke produced. Practically, therefore, the coke trade is concerned only with beehive coke and by-product coke, and to them the statistics of this report are confined. Although their product is interchangeable, there are fundamental differences between the beehive and by-product industries which must be kept in mind in examining the tables of this chapter. The competitive relations between the beehive and by-product industries have been discussed in previous reports of the Geological Survey[2] and need not be treated here.

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[2] U. S. Geol. Survey Mineral Resources, 1918, pt. 2, pp. 1446-1447, 1921; idem, 1921, pt. 2, p. 374, 1923.

Permanently higher prices for coal and gradually expanding markets for the by-products continue to foster the development of by-product coking, and the manufacture of beehive coke assumes more and more the character of an auxiliary agency called upon to furnish only the peak requirements of the metallurgical industry in times of active business.

Between the coal-gas and the by-product coke industries the line is increasingly difficult to draw. Adaptation of the by-product oven to the needs of city gas manufacture has brought into existence a number of installations of by-product ovens as a part of existing gas utilities. Still other coke plants that are financially independent of public utilities nevertheless supply gas under contract to public-utility distributors. From one point of view these plants are a part of the manufactured-gas industry. But considered with reference to coke-oven design and the technique of coke manufacture, and still more significantly with reference to the supply and demand for coke, they belong to the coke industry.

In the practical operation of a by-product coke plant the fact that the gas may be sold to a public utility and distributed through the city mains is of less consequence than the fact that the coke must be marketed in competition with other coke for foundry, furnace, or household use.

For the purpose of this report all installations of by-product ovens are included as a part of the by-product coke industry, and plants manufacturing coal gas and coke-oven gas on the same premises have been asked to make separate reports for these two branches of their business. The statistics here presented will therefore differ from the tabulations of the Census Bureau, for example, which classifies such installations of coke ovens as a part of the manufactured-gas industry.

On pages 798 and 799 of Mineral Resources for 1922, Part II, will be found a summary of the output of manufactured gas and by-products from all sources, including both coke ovens and coal-gas, oil-gas, and water-gas plants, from which the relation of the by-product coke industry to other methods of gas manufacture may be seen.

The principal statistical facts of the coke industry in 1923 are presented in Table 1.

TABLE 1.—*Salient figures of the coke industry in 1923*

	By-product	Beehive	Total
Coke produced:			
Quantity ... net tons	37, 597, 664	19, 379, 870	56, 977, 534
Value	$257, 591, 318	$115, 905, 580	$373, 496, 898
Screenings and breeze produced:			
Quantity ... net tons	3, 332, 714	229, 341	3, 562, 055
Value	$9, 048, 414	$563, 758	$9, 612, 172
Coal charged into ovens:			
Quantity ... net tons	54, 275, 577	30, 084, 366	84, 359, 943
Value	$258, 400, 990	$77, 037, 110	$335, 438, 100
Average value	$4. 76	$2. 56	$3. 98
Average yield in per cent of coal charged:			
Coke	69. 3	64. 4	67. 5
Breeze, quantity actually recovered	6. 1	2. 8	4. 2
Ovens:			
In existence Jan. 1	11, 212	63, 958	75, 170
In existence Dec. 31	11, 156	62, 349	73, 505
Dismantled during year	154	2, 490	2, 644
In course of construction Dec. 31	629	68	697
Daily coke capacity of ovens in existence Dec. 31 ... net tons	123, 447	(a)	(a)
Coke used by operator in blast furnace or affiliated works:			
Quantity ... net tons	27, 055, 397	2, 583, 507	29, 638, 904
Value	$168, 379, 600	$14, 045, 646	$182, 425, 246
Disposal of coke:			
Sold for furnace use to affiliated corporations—			
Quantity ... net tons	2, 313, 412	7, 923, 783	10, 237, 195
Value	$16, 307, 054	$45, 756, 993	$62, 064, 047
Merchant sales of furnace coke—			
Quantity ... net tons	1, 460, 538	6, 437, 771	7, 898, 309
Value	$9, 847, 055	$39, 326, 693	$49, 173, 748
Sold for foundry use—			
Quantity ... net tons	1, 897, 955	1, 702, 764	3, 600, 719
Value	$19, 995, 342	$12, 259, 196	$32, 254, 538
Sold for domestic use—			
Quantity ... net tons	2, 637, 518	95, 896	2, 733, 414
Value	$23, 872, 007	$461, 971	$24, 333, 978
Sold for industrial and other use—			
Quantity ... net tons	1, 638, 226	645, 662	2, 283, 888
Value	$14, 845, 652	$4, 112, 236	$18, 957, 888
Disposal of screenings and breeze:			
Used by operator—			
Quantity ... net tons	2, 178, 117	81, 889	2, 260, 006
Value	$4, 987, 623	$150, 775	$5, 138, 398
Sold—			
Quantity ... net tons	690, 338	57, 160	747, 498
Value	$2, 716, 845	$181, 618	$2, 898, 463
Average receipts per ton sold:			
Furnace coke (merchant sales)	$6. 74	$6. 11	$6. 23
Foundry coke	$10. 54	$7. 20	$8. 96
Domestic coke	$9. 05	$4. 82	$8. 90
Industrial and other coke	$9. 06	$6. 37	$8. 30
Screenings and breeze	$3. 94	$3. 18	$3. 88
By-products produced:			
Gas ... M cubic feet	601, 155, 293	-----	601, 155, 293
Tar ... gallons	440, 907, 109	-----	440, 907, 109
Ammonium sulphate or equivalent ... pounds	1, 150, 726, 370	-----	1, 150, 726, 370
Crude light oil ... gallons	135, 647, 175	-----	135, 647, 175
Value of by-products sold:			
Gas (surplus)	$51, 609, 220	-----	$51, 609, 220
Tar	$9, 250, 552	-----	$9, 250, 552
Ammonium sulphate or equivalent	$31, 708, 876	-----	$31, 708, 876
Crude light oil and derivatives	$19, 053, 334	-----	$19, 053, 334

[a] Data not available.

TABLE 2.—*Coke produced in by-product and beehive coke ovens in the United States, 1922–23*

[Exclusive of screenings and breeze]

State	By-product								Beehive						Total	
	Plants	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Ovens	Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
		Built	Under construction Dec. 31				Total	Per ton					Total	Per ton		
1922																
Alabama	7	1, 196		5, 115, 981	68. 3	3, 493, 656	$12, 972, 839	$3. 71	6, 460	509, 661	60. 1	306, 209	$1, 735, 406	$5. 67	3, 799, 865	$14, 708, 245
Colorado	1	120		528, 956	68. 9	364, 678	(a)	(a)	1, 758	183, 627	65. 0	119, 361	821, 309	6. 88	484, 039	(a)
Georgia									151	16, 178	54. 6	8, 832	74, 807	8. 47	8, 832	74, 807
Illinois	7	899		2, 876, 987	68. 9	1, 982, 906	18, 164, 549	9. 16							1, 982, 906	18, 164, 549
Indiana	6	1, 213		5, 509, 297	72. 5	3, 995, 505	28, 978, 431	7. 25							3, 995, 505	28, 978, 431
Kentucky	1	108		629, 012	72. 6	456, 645	3, 397, 439	7. 44	795	53, 660	56. 9	30, 522	216, 701	7. 10	487, 167	3, 614, 140
Maryland	1	300		799, 630	73. 8	589, 893	(a)	(a)							589, 893	(a)
Massachusetts	1	400		606, 589	67. 1	407, 081	(a)	(a)							407, 081	(a)
Michigan	3	390		1, 578, 357	72. 3	1, 142, 059	9, 229, 083	8. 08							1, 142, 059	9, 229, 083
Minnesota	3	220		688, 007	67. 2	462, 044	4, 641, 871	10. 05							462, 044	4, 641, 871
Missouri	1	64		(b)	(b)	(b)	(b)	(b)							(b)	(b)
New Jersey	2	252		1, 084, 781	72. 9	790, 811	(a)	(a)							790, 811	(a)
New Mexico									1, 030	141, 340	62. 0	87, 631	788, 679	9. 00	87, 631	788, 679
New York	4	692		2, 208, 162	67. 7	1, 494, 992	11, 865, 785	7. 93							1, 494, 992	11, 865, 785
Ohio	12	1, 558		7, 133, 358	68. 9	4, 911, 670	32, 387, 137	6. 59	205	153, 034	65. 0	99, 468	713, 186	7. 17	5, 011, 138	33, 100, 323
Oklahoma									300							
Pennsylvania	13	3, 154	366	10, 363, 792	69. 0	7, 151, 912	36, 702, 974	5. 13	38, 593	10, 416, 729	65. 6	6, 839, 980	38, 091, 586	5. 57	13, 991, 892	74, 794, 560
Rhode Island	1	40		(b)	(b)	(b)	(b)	(b)							(b)	(b)
Tennessee	1	24		37, 061	74. 1	27, 454	202, 336	7. 37	1, 822	174, 945	49. 4	86, 442	618, 542	7. 15	113, 896	820, 878
Utah									819	299, 499	57. 6	172, 453	1, 406, 109	8. 15	172, 453	1, 406, 109
Virginia									3, 372	601, 528	62. 9	378, 656	2, 291, 336	6. 05	378, 656	2, 291, 336
Washington	1	20		9, 390	59. 8	5, 611	44, 439	7. 92	408	40, 825	63. 8	26, 063	241, 442	9. 26	31, 674	285, 881
West Virginia	3	274	37	757, 877	66. 2	501, 894	3, 074, 934	6. 13	8, 245	694, 842	60. 1	417, 850	3, 037, 453	7. 27	919, 744	6, 112, 387
Wisconsin	2	288		(b)	(b)	(b)	(b)	(b)							(b)	(b)
Combined States				1, 125, 433	68. 6	771, 734	7, 520, 701	9. 75							771, 734	7, 520, 701
Undistributed							19, 094, 249	8. 86								19, 915, 558
	70	11, 212	403	41, 052, 670	69. 5	28, 550, 545	188, 276, 767	6. 59	63, 958	13, 285, 868	64. 5	8, 573, 467	50, 036, 556	5. 84	37, 124, 012	238, 313, 323

[a] Included under "Undistributed."

[b] Included under "Combined States."

TABLE 2.—*Coke produced in by-product and beehive coke ovens in the United States, 1922–23*—Continued

[Exclusive of screenings and breeze]

State	By-product								Beehive						Total	
	Plants	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Ovens	Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
		Built	Under construction Dec. 31				Total	Per ton					Total	Per ton		
1923																
Alabama	7	1,196		6,408,843	68.4	4,385,366	$18,156,491	$4.14	6,199	464,160	57.9	268,709	$1,660,903	$6.18	4,654,075	$19,817,394
Colorado	1	120		653,139	68.6	448,243	(a)	(a)	1,738	306,836	65.0	199,580	(a)	(a)	647,823	(a)
Georgia									151	24,161	52.0	12,556	126,690	10.09	12,556	126,690
Illinois	7	899		4,589,863	69.4	3,187,168	30,373,638	9.53							3,187,168	30,373,638
Indiana	6	1,213		7,143,914	70.6	5,042,614	46,765,264	9.27							5,042,614	46,765,264
Kentucky	1	108		582,385	74.5	434,116	(a)	(a)	795	230,539	54.5	125,595	874,752	6.96	559,711	(a)
Maryland	1	300		1,173,062	73.4	861,668	(a)	(a)							861,668	(a)
Massachusetts	1	400		797,833	69.4	554,125	(a)	(a)							554,125	(a)
Michigan	3	390	32	2,286,754	72.1	1,648,773	14,389,742	8.73							1,648,773	14,389,742
Minnesota	3	220		999,924	69.6	695,824	5,104,330	7.34							695,824	5,104,330
Missouri	1	64		(b)	(b)	(b)	(b)	(b)							(b)	(b)
New Jersey	2	252		1,207,605	74.3	897,569	(a)	(a)							897,569	(a)
New Mexico									1,030	(b)	(b)	(b)	(b)	(b)	(b)	(b)
New York	4	598	114	2,607,867	68.4	1,783,948	12,808,335	7.18							1,783,948	12,808,335
Ohio	12	1,619	84	9,290,435	68.1	6,323,810	40,712,282	6.44	205	230,455	65.0	149,796	(a)	(a)	6,473,606	(a)
Oklahoma									300	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Pennsylvania	12	3,094	366	13,407,952	68.5	9,185,747	43,520,249	4.74	37,578	25,177,492	65.3	16,438,539	94,923,942	5.77	25,624,286	138,444,191
Rhode Island	1	40		(b)	(b)	(b)	(b)	(b)							(b)	(b)
Tennessee	1	24		171,703	72.3	124,160	825,542	6.65	1,767	330,831	54.5	180,351	1,244,011	6.90	304,511	2,069,553
Utah			33						819	403,055	57.8	232,941	1,977,669	8.49	232,941	1,977,669
Virginia									3,284	1,241,159	62.4	774,887	5,086,612	6.56	774,887	5,086,612
Washington	1	20		54,811	56.7	31,081	237,148	7.63	408	55,730	68.2	37,987	347,364	9.14	69,068	584,512
West Virginia	4	311		1,400,864	67.2	940,866	5,345,432	5.68	8,055	1,354,982	60.7	821,909	5,758,284	7.01	1,762,775	11,103,716
Wisconsin	2	288		(b)	(b)	(b)	(b)	(b)							(b)	(b)
Combined States				1,498,623	70.2	1,052,586	11,926,300	11.33		264,966	51.7	137,020	1,157,400	8.44	1,189,606	13,083,700
Undistributed							27,426,565	8.54					2,747,953	7.86		71,761,552
	70	11,156	629	54,275,577	69.3	37,597,664	257,591,318	6.85	62,349	30,084,366	64.4	19,379,870	115,905,580	5.98	56,977,534	373,496,898

(a) Included under "Undistributed."

(b) Included under "Combined States."

GROWTH OF THE INDUSTRY

TABLE 3.—*Statistics of the manufacture of coke in the United States, 1880–1923*

Year	Plants	Ovens in existence	Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens [a]	
						Total	Per ton
1880	186	12, 372	5, 237, 741	63. 7	3, 338, 300	$6, 631, 267	$1. 99
1890	253	37, 158	18, 005, 209	63. 9	11, 508, 021	23, 215, 302	2. 02
1900	396	58, 484	32, 113, 553	63. 9	20, 533, 348	47, 443, 331	2. 31
1910	578	104, 440	63, 088, 327	66. 1	41, 708, 810	99, 742, 701	2. 39
1911	570	103, 879	53, 278, 248	66. 7	35, 551, 489	84, 130, 849	2. 37
1912	559	102, 230	65, 577, 862	67. 1	43, 983, 599	111, 805, 113	2. 54
1913	551	102, 650	69, 239, 190	66. 9	46, 299, 530	128, 922, 273	2. 78
1914	536	99, 755	51, 623, 750	66. 9	34, 555, 914	88, 334, 217	2. 56
1915	532	99, 378	61, 832, 898	67. 2	41, 581, 150	105, 503, 868	2. 54
1916	499	98, 864	81, 609, 460	66. 8	54, 533, 585	170, 841, 197	3. 13
1917	482	95, 896	83, 752, 371	66. 4	55, 606, 828	298, 243, 017	5. 36
1918	466	93, 914	85, 028, 018	66. 4	56, 478, 372	382, 324, 368	6. 77
1919	464	92, 939	65, 587, 918	67. 4	44, 180, 557	258, 339, 740	5. 85
1920	416	86, 179	76, 190, 832	67. 4	51, 345, 043	475, 981, 215	9. 27
1921	374	77, 156	37, 188, 557	68. 0	25, 287, 622	147, 673, 095	5. 84
1922	366	75, 170	54, 338, 538	68. 3	37, 124, 012	238, 313, 323	6. 42
1923	361	73, 505	84, 359, 943	67. 5	56, 977, 534	373, 496, 898	6. 56

Year	By-product coke				Beehive coke			
	Quantity		Value [a]		Quantity		Value [a]	
	Net tons	Per cent	Dollars	Per cent	Net tons	Per cent	Dollars	Per cent
1880	----------	--------	----------	--------	3, 338, 300	100. 0	6, 631, 267	100. 0
1885	----------	--------	----------	--------	5, 106, 696	100. 0	7, 629, 118	100. 0
1890	----------	--------	----------	--------	11, 508, 021	100. 0	23, 215, 302	100. 0
1893	12, 850	0. 1	(b)	(b)	9, 464, 730	99. 9	(b)	(b)
1900	1, 075, 727	5. 2	2, 635, 531	5. 6	19, 457, 621	94. 8	44, 807, 800	94. 4
1905	3, 462, 348	10. 7	10, 851, 730	15. 0	28, 768, 781	89. 3	61, 624, 466	85. 0
1910	7, 138, 734	17. 1	24, 793, 016	24. 9	34, 570, 076	82. 9	74, 949, 685	75. 1
1911	7, 847, 845	22. 1	27, 297, 897	32. 4	27, 703, 644	77. 9	56, 832, 952	67. 6
1912	11, 115, 164	25. 3	42, 632, 930	38. 1	32, 868, 435	74. 7	69, 172, 183	61. 9
1913	12, 714, 700	27. 5	48, 637, 852	37. 7	33, 584, 830	72. 5	80, 284, 421	62. 3
1914	11, 219, 943	32. 5	38, 080, 167	43. 1	23, 335, 971	67. 5	50, 254, 050	56. 9
1915	14, 072, 895	33. 8	48, 558, 325	46. 0	27, 508, 255	66. 2	56, 945, 543	54. 0
1916	19, 069, 361	35. 0	75, 373, 070	44. 1	35, 464, 224	65. 0	95, 468, 127	55. 9
1917	22, 439, 280	40. 4	138, 643, 153	46. 5	33, 167, 548	59. 6	159, 599, 864	53. 5
1918	25, 997, 580	46. 0	193, 018, 785	50. 5	30, 480, 792	54. 0	189, 305, 583	49. 5
1919	25, 137, 621	56. 9	160, 244, 768	62. 0	19, 042, 936	43. 1	98, 094, 972	38. 0
1920	30, 833, 951	60. 0	313, 028, 732	65. 8	20, 511, 092	40. 0	162, 952, 483	34. 2
1921	19, 749, 580	78. 1	117, 506, 646	79. 6	5, 538, 042	21. 9	30, 166, 449	20. 4
1922	28, 550, 545	76. 9	188, 276, 767	79. 0	8, 573, 467	23. 1	50, 036, 556	21. 0
1923	37, 597, 664	66. 0	257, 591, 318	69. 0	19, 379, 870	34. 0	115, 905, 580	31. 0

[a] The figures of value are not strictly comparable because the value of that part of the product consumed by the producer in associated iron furnaces but not sold has been arrived at in different ways. Prior to 1918, and also in 1919, 1921, 1922, and 1923, the value of this coke is that reported by the producer. For 1918 and 1920 it has been estimated by the Geological Survey for each State at the average value for that State of the part of the product reported sold. Value of screenings and breeze not included.

[b] Figures not available.

MONTHLY AND WEEKLY PRODUCTION

TABLE 4.—*By-product coke produced in the United States, 1912–1923, by months and average per day, in net tons* [a]

Month	1912		1913		1914		1915	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
January	778, 000	25, 000	1, 081, 000	35, 000	898, 000	29, 000	858, 000	28, 000
February	778, 000	27, 000	1, 030, 000	37, 000	853, 000	30, 000	844, 000	30, 000
March	878, 000	28, 000	1, 132, 000	37, 000	1, 032, 000	33, 000	971, 000	31, 000
April	845, 000	28, 000	1, 030, 000	34, 000	987, 000	33, 000	1, 027, 000	34, 000
May	900, 000	29, 000	1, 055, 000	34, 000	976, 000	31, 000	1, 084, 000	35, 000
June	923, 000	31, 000	1, 068, 000	36, 000	920, 000	31, 000	1, 098, 000	31, 000
July	967, 000	31, 000	1, 094, 000	35, 000	954, 000	31, 000	1, 196, 000	39, 000
August	1, 000, 000	32, 000	1, 144, 000	37, 000	1, 010, 000	33, 000	1, 281, 000	41, 000
September	978, 000	33, 000	1, 119, 000	37, 000	976, 000	33, 000	1, 337, 000	45, 000
October	1, 023, 000	33, 000	1, 093, 000	35, 000	942, 000	30, 000	1, 421, 000	46, 000
November	1, 056, 000	35, 000	992, 000	33, 000	830, 000	28, 000	1, 450, 000	48, 000
December	989, 000	32, 000	877, 000	28, 000	842, 000	27, 000	1, 506, 000	49, 000
	11, 115, 000	30, 000	12, 715, 000	35, 000	11, 220, 000	31, 000	14, 073, 000	36, 000

Month	1916		1917		1918		1919	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
January	1, 506, 000	49, 000	1, 788, 000	58, 000	1, 638, 000	53, 000	2, 445, 000	79, 000
February	1, 449, 000	50, 000	1, 807, 000	65, 000	1, 534, 000	55, 000	2, 153, 000	77, 000
March	1, 564, 000	50, 000	1, 813, 000	58, 000	2, 028, 000	65, 000	2, 285, 000	74, 000
April	1, 506, 000	50, 000	1, 859, 000	62, 000	2, 002, 000	67, 000	2, 025, 000	68, 000
May	1, 583, 000	51, 000	1, 879, 000	61, 000	2, 106, 000	68, 000	1, 906, 000	61, 000
June	1, 526, 000	51, 000	1, 880, 000	63, 000	2, 080, 000	69, 000	1, 935, 000	65, 000
July	1, 583, 000	51, 000	1, 882, 000	61, 000	2, 288, 000	74, 000	2, 244, 000	72, 000
August	1, 621, 000	52, 000	1, 915, 000	62, 000	2, 366, 000	76, 000	2, 266, 000	73, 000
September	1, 621, 000	54, 000	1, 919, 000	64, 000	2, 392, 000	80, 000	2, 168, 000	72, 000
October	1, 716, 000	55, 000	1, 898, 000	61, 000	2, 547, 000	82, 000	1, 748, 000	56, 000
November	1, 659, 000	55, 000	1, 900, 000	63, 000	2, 496, 000	83, 000	1, 971, 000	66, 000
December	1, 735, 000	56, 000	1, 899, 000	61, 000	2, 521, 000	81, 000	1, 992, 000	64, 000
	19, 069, 000	52, 000	22, 439, 000	61, 000	25, 998, 000	71, 000	25, 138, 000	69, 000

Month	1920		1921		1922		1923	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
January	2, 426, 000	78, 000	2, 259, 000	73, 000	1, 886, 000	61, 000	3, 102, 000	100, 000
February	2, 343, 000	81, 000	1, 872, 000	67, 000	1, 800, 000	64, 000	2, 862, 000	102, 000
March	2, 646, 000	85, 000	1, 757, 000	57, 000	2, 137, 000	69, 000	3, 258, 000	105, 000
April	2, 267, 000	75, 000	1, 506, 000	50, 000	2, 206, 000	74, 000	3, 208, 000	107, 000
May	2, 400, 000	77, 000	1, 577, 000	51, 000	2, 544, 000	82, 000	3, 330, 000	107, 000
June	2, 487, 000	83, 000	1, 396, 000	47, 000	2, 594, 000	86, 000	3, 168, 000	106, 000
July	2, 658, 000	86, 000	1, 286, 000	41, 000	2, 501, 000	81, 000	3, 268, 000	105, 000
August	2, 742, 000	88, 000	1, 371, 000	44, 000	1, 822, 000	59, 000	3, 241, 000	105, 000
September	2, 744, 000	91, 000	1, 411, 000	47, 000	2, 249, 000	75, 000	3, 115, 000	104, 000
October	2, 915, 000	94, 000	1, 720, 000	55, 000	2, 812, 000	91, 000	3, 102, 000	100, 000
November	2, 679, 000	89, 000	1, 751, 000	58, 000	2, 931, 000	98, 000	2, 943, 000	98, 000
December	2, 527, 000	82, 000	1, 844, 000	59, 000	3, 069, 000	99, 000	3, 001, 000	97, 000
	30, 834, 000	84, 000	19, 750, 000	54, 000	28, 551, 000	78, 000	37, 598, 000	103, 000

[a] Exclusive of screenings and breeze. Based upon reports by the operators.

TABLE 5.—*Beehive coke produced in the United States, 1912–1923, by months, and average per working day, in net tons* [a]

Month	1912		1913		1914		1915	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
January	2,553,000	98,000	3,124,000	120,000	2,105,000	81,000	1,446,000	55,000
February	2,589,000	104,000	2,880,000	120,000	2,137,000	89,000	1,583,000	66,000
March	2,879,000	111,000	2,910,000	112,000	2,653,000	102,000	1,865,000	69,000
April	2,771,000	107,000	2,896,000	111,000	1,343,000	90,000	1,841,000	71,000
May	2,884,000	107,000	3,001,000	111,000	1,993,000	74,000	1,936,000	74,000
June	2,657,000	106,000	2,807,000	112,000	1,890,000	73,000	2,210,000	85,000
July	2,538,000	98,000	2,833,000	109,000	1,977,000	76,000	2,345,000	90,000
August	2,778,000	103,000	2,810,000	108,000	1,888,000	73,000	2,553,000	98,000
September	2,573,000	103,000	2,750,000	106,000	1,793,000	69,000	2,582,000	99,000
October	2,941,000	109,000	2,870,000	106,000	1,665,000	62,000	3,029,000	116,000
November	2,895,000	111,000	2,500,000	100,000	1,363,000	55,000	3,025,000	116,000
December	2,810,000	108,000	2,204,000	82,000	1,529,000	57,000	3,093,000	119,000
	32,868,000	105,000	33,585,000	108,000	23,336,000	75,000	27,508,000	88,000

Month	1916		1917		1918		1919	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
January	2,919,000	112,000	2,923,000	108,000	2,256,000	84,000	2,366,000	88,000
February	2,887,000	115,000	2,490,000	104,000	2,225,000	93,000	1,767,000	74,000
March	3,263,000	121,000	3,139,000	116,000	2,652,000	102,000	1,714,000	66,000
April	2,875,000	115,000	2,814,000	113,000	2,591,000	100,000	1,277,000	49,000
May	3,044,000	113,000	2,861,000	106,000	2,743,000	102,000	1,101,000	41,000
June	2,918,000	112,000	2,755,000	106,000	2,713,000	109,000	1,143,000	46,000
July	2,721,000	109,000	2,754,000	110,000	2,835,000	109,000	1,457,000	56,000
August	2,999,000	111,000	2,650,000	98,000	2,650,000	98,000	1,681,000	65,000
September	3,016,000	116,000	2,727,000	109,000	2,591,000	104,000	1,736,000	67,000
October	3,079,000	118,000	2,780,000	103,000	2,621,000	97,000	1,504,000	56,000
November	2,934,000	113,000	2,677,000	103,000	2,348,000	90,000	1,629,000	65,000
December	2,809,000	108,000	2,598,000	104,000	2,256,000	90,000	1,668,000	64,000
	35,464,000	114,000	33,168,000	107,000	30,481,000	98,000	19,043,000	61,000

Month	1920		1921		1922		1923	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
January	1,946,000	72,000	1,088,000	42,000	529,000	20,000	1,594,000	59,000
February	1,705,000	71,000	870,000	36,000	586,000	24,000	1,598,000	67,000
March	1,976,000	73,000	578,000	21,000	781,000	29,000	1,886,000	70,000
April	1,579,000	61,000	330,000	13,000	564,000	23,000	1,914,000	77,000
May	1,671,000	64,000	302,000	12,000	465,000	17,000	1,972,000	73,000
June	1,683,000	65,000	233,000	9,000	491,000	19,000	1,892,000	73,000
July	1,666,000	64,000	181,000	7,000	476,000	19,000	1,706,000	68,000
August	1,749,000	67,000	250,000	9,000	567,000	21,000	1,611,000	60,000
September	1,731,000	67,000	291,000	11,000	649,000	25,000	1,480,000	59,000
October	1,716,000	66,000	418,000	16,000	935,000	36,000	1,391,000	52,000
November	1,605,000	62,000	480,000	18,000	1,214,000	47,000	1,189,000	46,000
December	1,484,000	57,000	517,000	20,000	1,316,000	53,000	1,147,000	46,000
	20,511,000	66,000	5,538,000	18,000	8,573,000	28,000	19,380,000	62,000

[a] Based on railroad shipments and prorated to the total production reported by operators.

TABLE 6.—*Total coke produced in the United States, 1912–1923, by months, in net tons*

Month	1912	1913	1914	1915	1916	1917
January	3, 331, 000	4, 205, 000	3, 003, 000	2, 304, 000	4, 425, 000	4, 711, 000
February	3, 367, 000	3, 910, 000	2, 990, 000	2, 427, 000	4, 336, 000	4, 297, 000
March	3, 757, 000	4, 042, 000	3, 685, 000	2, 836, 000	4, 827, 000	4, 952, 000
April	3, 616, 000	3, 926, 000	3, 330, 000	2, 868, 000	4, 381, 000	4, 673, 000
May	3, 784, 000	4, 056, 000	2, 969, 000	3, 020, 000	4, 627, 000	4, 740, 000
June	3, 580, 000	3, 875, 000	2, 810, 000	3, 308, 000	4, 444, 000	4, 635. 000
July	3, 505, 000	3, 927, 000	2, 931, 000	3, 541, 000	4, 304, 000	4, 636, 000
August	3, 778, 000	3, 954, 000	2, 898, 000	3, 834, 000	4. 620, 000	4, 565, 000
September	3, 551, 000	3. 869, 000	2, 769, 000	3, 919, 000	4, 637, 000	4, 646, 000
October	3, 964, 000	3, 963, 000	2, 607, 000	4, 450, 000	4, 795, 000	4, 678, 000
November	3, 951, 000	3, 492, 000	2, 193, 000	4, 475, 000	4, 593, 000	4, 577, 000
December	3, 799, 000	3, 081, 000	2, 371, 000	4, 599, 000	4, 544, 000	4, 497, 000
	43, 983, 000	46, 300, 000	34, 556, 000	41, 581, 000	54, 533, 000	55, 607, 000

Month	1918	1919	1920	1921	1922	1923
January	3, 894, 000	4, 811, 000	4, 372, 000	3, 347, 000	2, 415, 000	4, 696, 000
February	3, 759, 000	3, 920, 000	4, 048, 000	2, 742, 000	2, 386, 000	4, 460, 000
March	4, 680, 000	3, 999, 000	4, 622, 000	2, 335, 000	2, 918, 000	5, 144, 000
April	4, 593, 000	3, 302, 000	3, 846, 000	1, 836, 000	2, 770, 000	5, 122, 000
May	4, 849, 000	3, 007, 000	4, 071, 000	1, 879, 000	3, 009, 000	5, 302, 000
June	4, 793, 000	3, 078, 000	4, 170, 000	1, 629, 000	3, 085, 000	5, 060, 000
July	5, 123, 000	3, 701, 000	4, 324, 000	1, 467, 000	2, 977, 000	4, 974, 000
August	5, 016, 000	3, 947, 000	4, 491, 000	1, 621, 000	2, 389, 000	4, 852, 000
September	4, 983, 000	3, 904, 000	4, 475, 000	1, 702, 000	2, 898, 000	4, 595, 000
October	5, 168, 000	3, 252, 000	4, 631, 000	2, 138, 000	3, 747, 000	4, 493, 000
November	4, 844, 000	3, 600, 000	4, 284, 000	2, 231, 000	4, 145, 000	4, 132, 000
December	4, 777, 000	3, 660, 000	4, 011, 000	2, 361, 000	4, 385, 000	4, 148, 000
	56, 479, 000	44, 181, 000	51, 345, 000	25, 288, 000	37, 124, 000	56, 978, 000

TABLE 7.—*Beehive coke produced in the United States, 1922–23, by weeks*

[Estimated from railroad shipments]

1922

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 7	116,000	May 13	103,000	Sept. 16	132,000
14	127,000	20	106,000	23	148,000
21	123,000	27	103,000	30	173,000
28	120,000	June 3	104,000	Oct. 7	184,000
Feb. 4	130,000	10	106,000	14	198,000
11	137,000	17	113,000	21	224,000
18	144,000	24	118,000	28	253,000
25	167,000	July 1	122,000	Nov. 4	227,000
Mar. 4	153,000	8	101,000	11	262,000
11	164,000	15	107,000	18	281,000
18	159,000	22	111,000	25	307,000
25	186,000	29	119,000	Dec. 2	318,000
Apr. 1	204,000	Aug. 5	118,000	9	310,000
8	186,000	12	119,000	16	319,000
15	149,000	19	128,000	23	300,000
22	100,000	26	124,000	30	281,000
29	95,000	Sept. 2	147,000		
May 6	101,000	9	146,000		8,573,000

1923

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 6	333,000	May 19	443,000	Sept. 29	347,000
13	349,000	26	447,000	Oct. 6	337,000
20	354,000	June 2	427,000	13	306,000
27	370,000	9	437,000	20	308,000
Feb. 3	375,000	16	438,000	27	298,000
10	387,000	23	429,000	Nov. 3	287,000
17	408,000	30	430,000	10	275,000
24	400,000	July 7	406,000	17	274,000
Mar. 3	434,000	14	395,000	24	277,000
10	395,000	21	390,000	Dec. 1	264,000
17	442,000	28	392,000	8	286,000
24	415,000	Aug. 4	373,000	15	260,000
31	419,000	11	352,000	22	276,000
Apr. 7	462,000	18	360,000	29	240,000
14	454,000	25	353,000	30–31	42,000
21	470,000	Sept. 1	360,000		
28	457,000	8	372,000		19,380,000
May 5	439,000	15	342,000		
12	433,000	22	361,000		

TABLE 8.—*Monthly production of by-product coke in the United States, 1922–23, by States, in net tons* [a]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
1922													
Alabama	208, 000	191, 000	245, 000	255, 000	293, 000	300, 000	322, 000	331, 000	326, 000	342, 000	335, 000	345, 000	3, 493, 000
Colorado	17, 000	30, 000	34, 000	38, 000	50, 000	49, 000	44, 000	16, 000	19, 000	20, 000	19, 000	29, 000	365, 000
Illinois	145, 000	133, 000	175, 000	159, 000	171, 000	176, 000	165, 000	120, 000	125, 000	183, 000	199, 000	232, 000	1, 983, 000
Indiana	257, 000	235, 000	292, 000	340, 000	387, 000	400, 000	363, 000	233, 000	293, 000	372, 000	406, 000	417, 000	3, 995, 000
Kentucky	35, 000	32, 000	39, 000	38, 000	41, 000	41, 000	41, 000	35, 000	31, 000	42, 000	39, 000	43, 000	457, 000
Maryland	29, 000	27, 000	28, 000	29, 000	59, 000	57, 000	63, 000	33, 000	43, 000	72, 000	74, 000	76, 000	590, 000
Massachusetts	32, 000	27, 000	30, 000	26, 000	27, 000	30, 000	33, 000	28, 000	42, 000	46, 000	43, 000	43, 000	407, 000
Michigan	84, 000	75, 000	90, 000	96, 000	100, 000	96, 000	101, 000	86, 000	80, 000	102, 000	112, 000	120, 000	1, 142, 000
Minnesota	30, 000	28, 000	31, 000	32, 000	36, 000	34, 000	38, 000	35, 000	39, 000	49, 000	56, 000	54, 000	462, 000
New Jersey	56, 000	55, 000	59, 000	61, 000	63, 000	63, 000	65, 000	67, 000	70, 000	72, 000	78, 000	82, 000	791, 000
New York	103, 000	93, 000	111, 000	132, 000	138, 000	137, 000	132, 000	66, 000	120, 000	153, 000	153, 000	157, 000	1, 495, 000
Ohio	328, 000	332, 000	374, 000	363, 000	433, 000	481, 000	427, 000	229, 000	378, 000	501, 000	523, 000	543, 000	4, 912, 000
Pennsylvania	479, 000	470, 000	538, 000	544, 000	635, 000	626, 000	592, 000	466, 000	598, 000	720, 000	734, 000	750, 000	7, 152, 000
Tennessee	----------	----------	----------	----------	----------	----------	----------	----------	----------	4, 000	11, 000	12, 000	27, 000
Washington [b]	3, 000	3, 000	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	6, 000
West Virginia	34, 000	28, 000	46, 000	37, 000	45, 000	48, 000	44, 000	25, 000	25, 000	47, 000	56, 000	67, 000	502, 000
Missouri, Rhode Island, and Wisconsin	46, 000	41, 000	45, 000	56, 000	66, 000	56, 000	71, 000	52, 000	60, 000	87, 000	93, 000	99, 000	772, 000
	1, 886, 000	1, 800, 000	2, 137, 000	2, 206, 000	2, 544, 000	2, 594, 000	2, 501, 000	1, 822, 000	2, 249, 000	2, 812, 000	2, 931, 000	3, 069, 000	28, 551, 000
1923													
Alabama	362, 000	328, 000	375, 000	369, 000	390, 000	373, 000	382, 000	378, 000	364, 000	363, 000	350, 000	351, 000	4, 385, 000
Colorado	49, 000	45, 000	51, 000	48, 000	50, 000	50, 000	33, 000	22, 000	22, 000	24, 000	22, 000	32, 000	448, 000
Illinois	244, 000	227, 000	248, 000	265, 000	290, 000	281, 000	284, 000	281, 000	266, 000	267, 000	259, 000	275, 000	3, 187, 000
Indiana	418, 000	377, 000	426, 000	426, 000	440, 000	414, 000	425, 000	427, 000	409, 000	433, 000	423, 000	425, 000	5, 043, 000
Kentucky	45, 000	41, 000	44, 000	43, 000	39, 000	32, 000	32, 000	36, 000	39, 000	36, 000	27, 000	20, 000	434, 000
Maryland	69, 000	75, 000	97, 000	88, 000	88, 000	62, 000	68, 000	66, 000	60, 000	58, 000	65, 000	66, 000	862, 000
Massachusetts	41, 000	40, 000	49, 000	47, 000	49, 000	45, 000	50, 000	51, 000	48, 000	50, 000	46, 000	38, 000	554, 000
Michigan	127, 000	123, 000	142, 000	137, 000	141, 000	133, 000	140, 000	145, 000	140, 000	142, 000	138, 000	141, 000	1, 649, 000
Minnesota	58, 000	54, 000	60, 000	57, 000	59, 000	54, 000	55, 000	56, 000	59, 000	63, 000	59, 000	62, 000	696, 000
New Jersey	79, 000	74, 000	77, 000	74, 000	76, 000	71, 000	74, 000	71, 000	74, 000	78, 000	79, 000	70, 000	897, 000
New York	155, 000	135, 000	162, 000	157, 000	157, 000	151, 000	154, 000	153, 000	138, 000	139, 000	136, 000	147, 000	1, 784, 000
Ohio	548, 000	516, 000	573, 000	548, 000	549, 000	508, 000	541, 000	542, 000	517, 000	506, 000	484, 000	492, 000	6, 324, 000
Pennsylvania	722, 000	654, 000	766, 000	770, 000	824, 000	828, 000	851, 000	826, 000	788, 000	758, 000	688, 000	711, 000	9, 186, 000
Tennessee	12, 000	11, 000	12, 000	12, 000	12, 000	12, 000	12, 000	9, 000	10, 000	9, 000	6, 000	7, 000	124, 000
Washington	1, 000	3, 000	2, 000	3, 000	3, 000	3, 000	3, 000	3, 000	3, 000	2, 000	2, 000	3, 000	31, 000
West Virginia	73, 000	67, 000	73, 000	71, 000	72, 000	71, 000	84, 000	87, 000	88, 000	86, 000	82, 000	87, 000	941, 000
Missouri, Rhode Island, and Wisconsin	99, 000	92, 000	101, 000	93, 000	91, 000	80, 000	80, 000	88, 000	90, 000	88, 000	77, 000	74, 000	1, 053, 000
	3, 102, 000	2, 862, 000	3, 258, 000	3, 208, 000	3, 330, 000	3, 168, 000	3, 268, 000	3, 241, 000	3, 115, 000	3, 102, 000	2, 943, 000	3, 001, 000	37, 598, 000

[a] Based upon monthly reports from all producers.

[b] Partly estimated.

PRODUCTION BY FURNACE AND NONFURNACE OVENS

TABLE 9.—*Number and production of by-product coke plants connected with iron furnaces and by all other plants, 1913–1923* [a]

Year	Number of active plants		Coke produced (net tons)		Percentage of production	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
1913	21	15	9, 346, 855	3, 367, 845	73. 5	26. 5
1914	23	14	8, 029, 727	3, 190, 216	71. 6	28. 4
1915	24	16	10, 448, 015	3, 624, 880	74. 2	25. 8
1916	29	17	14, 446, 576	4, 622, 785	75. 8	24. 2
1917	33	19	17, 321, 145	5, 118, 135	77. 2	22. 8
1918	39	21	20, 124, 218	5, 873, 362	77. 4	22. 6
1919	43	22	20, 019, 097	5, 118, 524	79. 6	20. 4
1920	45	23	25, 212, 745	5, 621, 206	81. 8	18. 2
1921	45	22	16, 231, 374	3, 518, 206	82. 2	17. 8
1922	43	21	23, 889, 702	4, 660, 843	83. 7	16. 3
1923	44	21	31, 117, 323	6, 480, 341	82. 8	17. 2

[a] For classification of individual plants as "furnace" and "other," see Table 22.

TABLE 10.—*Monthly and average daily production of by-product coke by plants associated with iron furnaces and by all other plants, 1921–1923, in net tons* [a]

	1921		1922		1923	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
Monthly production:						
January	1, 878, 000	381, 000	1, 555, 000	331, 000	2, 573, 000	529, 000
February	1, 540, 000	332, 000	1, 501, 000	299, 000	2, 360, 000	502, 000
March	1, 429, 000	328, 000	1, 781, 000	356, 000	2, 695, 000	563, 000
April	1, 211, 000	295, 000	1, 846, 000	360, 000	2, 655, 000	553, 000
May	1, 279, 000	298, 000	2, 176, 000	368, 000	2, 759, 000	571, 000
June	1, 153, 000	243, 000	2, 222, 000	372, 000	2, 638, 000	530, 000
July	1, 042, 000	244, 000	2, 152, 000	349, 000	2, 726, 000	542, 000
August	1, 137, 000	234, 000	1, 463, 000	359, 000	2, 687, 000	554, 000
September	1, 183, 000	228, 000	1, 859, 000	390, 000	2, 565, 000	550, 000
October	1, 445, 000	275, 000	2, 343, 000	469, 000	2, 553, 000	549, 000
November	1, 476, 000	275, 000	2, 436, 000	495, 000	2, 422, 000	521, 000
December	1, 565, 000	279, 000	2, 546, 000	523, 000	2, 484, 000	517, 000
	16, 338, 000	3, 412, 000	23, 880, 000	4, 671, 000	31, 117, 000	6, 481, 000
Average daily production:						
January	60, 600	12, 300	50, 200	10, 700	83, 000	17, 000
February	55, 000	11, 800	53, 600	10, 700	84, 000	18, 000
March	46, 100	10, 600	57, 400	11, 500	87, 000	18, 000
April	40, 300	9, 900	61, 500	12, 000	89, 000	18, 000
May	41, 200	9, 600	70, 200	11, 900	89, 000	18, 000
June	38, 400	8, 100	74, 100	12, 400	88, 000	18, 000
July	33, 600	7, 800	69, 400	11, 300	88, 000	17, 000
August	36, 700	7, 500	47, 200	11, 600	87, 000	18, 000
September	39, 400	7, 600	62, 000	13, 000	85, 000	18, 000
October	46, 600	8, 900	75, 600	15, 100	82, 000	18, 000
November	49, 200	9, 200	81, 200	16, 500	81, 000	17, 000
December	50, 500	9, 000	82, 100	16, 900	80, 000	17, 000
Average	44, 800	9, 300	65, 400	12, 800	85, 000	18, 000

[a] For the classification of individual plants as "furnace" and "other," see Table 22.

TABLE 11.—*Percentage of total monthly output of by-product coke that was produced by plants associated with iron furnaces and by other plants, 1921–1923* [a]

Month	1921		1922		1923	
	Furnace plants	Other plants	Furnace plants	Other plants	Furnace plants	Other plants
January	83.1	16.9	82.4	17.6	83.0	17.0
February	82.3	17.7	83.3	16.7	82.5	17.5
March	81.3	18.7	83.3	16.7	82.7	17.3
April	80.3	19.7	83.7	16.3	82.8	17.2
May	81.1	18.9	85.5	14.5	82.9	17.1
June	82.6	17.4	85.7	14.3	83.3	16.7
July	81.2	18.8	86.0	14.0	83.4	16.6
August	83.0	17.0	80.3	19.7	82.9	17.1
September	83.8	16.2	82.7	17.3	82.3	17.7
October	84.0	16.0	83.3	16.7	82.3	17.7
November	84.2	15.8	83.1	16.9	82.3	17.7
December	84.9	15.1	82.9	17.1	82.8	17.2
	82.2	17.8	83.7	16.3	82.8	17.2

[a] For classification of individual plants as "furnace" and "other," see Table 22.

PRODUCTION BY STATES AND DISTRICTS

TABLE 12.—*Coke produced in the United States, 1920–1923, in net tons*

State	1920	1921	1922	1923	Increase, 1923			
					Quantity	Percentage		
						Total	By-product	Beehive
Alabama	4,013,891	2,534,039	3,799,865	4,654,075	854,210	22	26	[a] 12
Colorado	789,499	368,131	484,039	647,823	163,784	34	23	67
Georgia	16,523	6,943	8,832	12,556	3,724	42	------	42
Illinois	2,136,793	1,322,178	1,982,906	3,187,168	1,204,262	61	61	------
Indiana	4,553,697	3,091,263	3,995,505	5,042,614	1,047,109	26	26	------
Kentucky	739,577	284,825	487,167	559,711	72,544	15	[a] 5	311
Maryland	682,132	292,439	589,893	861,668	271,775	46	46	------
Massachusetts	488,089	294,059	407,081	554,125	147,044	36	36	------
Michigan	1,393,445	777,125	1,142,059	1,648,773	506,714	44	44	------
Minnesota	674,801	435,866	462,044	695,824	233,780	51	51	------
Missouri	([b])	([b])	([b])	([b])	([b])	([b])	([b])	------
New Jersey	725,571	739,768	790,811	897,569	106,758	13	13	------
New Mexico	([b])	([b])	87,631	([b])	([b])	([b])	------	([b])
New York	1,040,192	746,916	1,494,992	1,783,948	288,956	19	19	------
Ohio	5,701,810	3,028,423	5,011,138	6,473,606	1,462,468	29	29	51
Oklahoma	([b])	------------	------------	([b])	([b])	([b])	------	([b])
Pennsylvania	23,638,739	9,769,476	13,991,892	25,624,286	11,632,394	83	28	140
Rhode Island	([b])	([b])	([b])	([b])	([b])	([b])	([b])	------
Tennessee	301,708	85,728	113,896	304,511	190,615	167	352	109
Utah	([b])	([b])	172,453	232,941	60,488	35	------	35
Virginia	1,027,788	280,476	378,656	774,887	396,231	105	------	105
Washington	59,395	27,260	31,674	69,068	37,394	118	454	46
West Virginia	1,828,336	397,892	919,744	1,762,775	843,031	92	87	97
Wisconsin	([b])	([b])	([b])	([b])	([b])	([b])	([b])	------
Combined States	1,533,057	804,815	771,734	1,189,606	330,241	38	36	56
	51,345,043	25,287,622	37,124,012	56,977,534	19,853,522	53	32	126

[a] Decrease.

[b] Included under "Combined States."

TABLE 13.—*By-product and beehive coke produced in the United States, 1918 and 1920–1923, in net tons*

State	1918	1920	1921	1922	1923
By-product					
Alabama	2,634,451	3,123,890	2,401,127	3,493,656	4,385,366
Colorado	230,663	516,673	286,755	364,678	448,243
Illinois	2,285,610	2,136,793	1,322,178	1,982,906	3,187,168
Indiana	3,898,215	4,553,697	3,091,263	3,995,505	5,042,614
Kentucky	517,749	466,985	185,383	456,645	434,116
Maryland	474,368	682,132	292,439	589,893	861,668
Massachusetts	556,397	488,089	294,059	407,081	554,125
Michigan	(a)	1,393,445	777,125	1,142,059	1,648,773
Minnesota	784,065	674,801	435,866	462,044	695,824
Missouri	(a)	(a)	(a)	(a)	(a)
New Jersey	682,148	725,571	739,768	790,811	897,569
New York	1,069,587	1,040,192	746,916	1,494,992	1,783,948
Ohio	5,226,334	5,614,877	2,966,273	4,911,670	6,323,810
Pennsylvania	4,586,981	7,730,256	5,303,371	7,151,912	9,185,747
Rhode Island	----------	(a)	(a)	(a)	(a)
Tennessee	124,469	139,121	57,723	27,454	124,160
Washington	30,129	26,284	23,765	5,611	31,081
West Virginia	603,393	447,392	188,355	501,894	940,866
Wisconsin	(a)	(a)	(a)	(a)	(a)
Combined States	2,293,021	1,073,753	637,214	771,734	1,052,586
	25,997,580	30,833,951	19,749,580	28,550,545	37,597,664
Beehive					
Alabama	1,717,721	890,001	132,912	306,209	268,709
Colorado	758,784	272,826	81,376	119,361	199,580
Georgia	22,048	16,523	6,943	8,832	12,556
Kentucky	301,036	272,592	99,442	30,522	125,595
New Mexico	597,072	(a)	(a)	87,631	(a)
Ohio	138,909	86,933	62,150	99,468	149,796
Oklahoma	(a)	----------	----------	----------	(a)
Pennsylvania	22,136,664	15,908,483	4,466,105	6,839,980	16,438,539
Tennessee	302,637	162,587	28,005	86,442	180,351
Utah	(a)	(a)	(a)	172,453	232,941
Virginia	1,234,256	1,027,788	280,476	378,656	774,887
Washington	93,659	33,111	3,495	26,063	37,987
West Virginia	2,716,613	1,380,944	209,537	417,850	821,909
Combined States	461,393	459,304	167,601	----------	137,020
	30,480,792	20,511,092	5,538,042	8,573,467	19,379,870

[a] Included under "Combined States."

TABLE 14.—*Rank of the States in the production of coke, 1919–1923*

State	1919		1920		1921		1922		1923	
	All coke	By-product coke	All coke	By-product coke	All coke	By-product coke	All coke	By-product coke	All coke	By-product coke
Pennsylvania	1	1	1	1	1	1	1	1	1	1
Ohio	2	2	2	2	3	3	2	2	2	2
Indiana	3	3	3	3	2	2	3	3	3	3
Alabama	4	4	4	4	4	4	4	4	4	4
Illinois	5	5	5	5	5	5	5	5	5	5
New York	11	9	8	7	7	7	6	6	6	6
West Virginia	6	14	6	15	10	15	8	10	7	8
Michigan	9	7	7	6	6	6	7	7	8	7
New Jersey	10	8	12	8	8	8	9	8	9	9
Maryland	16	15	14	10	14	12	10	9	10	10
Virginia	7	------	9	------	16	------	16	------	11	------
Minnesota	14	10	15	11	9	9	13	11	12	11
Colorado	13	11	10	12	11	13	12	15	13	14
Wisconsin	8	6	13	9	12	10	14	13	14	12
Kentucky	12	12	11	14	15	16	11	12	15	15
Massachusetts	15	13	16	13	13	11	15	14	16	13
Tennessee	17	18	17	17	20	18	20	18	17	18
Missouri	19	16	19	16	17	14	17	16	18	16
Utah	20	------	20	------	18	------	18	------	19	------
Rhode Island	21	17	21	18	19	17	19	17	20	17
New Mexico	18	------	18	------	22	------	21	------	21	------
Washington	22	19	22	19	21	19	22	19	22	19
Georgia	23	------	23	------	23	------	23	------	23	------
Oklahoma	24	------	------	------	------	------	------	------	24	------

TABLE 15.—*By-product and beehive coke produced in Pennsylvania, 1922–23, by districts*

District	Plants	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens	
		Built	Under construction				Total	Per ton
1922								
By-product:								
Eastern Pennsylvania [a]	5	844	-------	2, 245, 341	71. 3	1, 600, 504	$11, 533, 016	$7. 21
Western Pennsylvania [b]	8	2, 310	366	8, 118, 451	68. 4	5, 551, 408	25, 169, 958	4. 53
	13	3, 154	366	10, 363, 792	69. 0	7, 151, 912	36, 702, 974	5. 13
Beehive:								
Allegheny Mountain and Allegheny Valley	7	678	-------	177, 868	60. 9	108, 264	938, 114	8. 66
Connellsville	68	16, 334	-------	5, 900, 104	66. 3	3, 913, 229	20, 423, 667	5. 22
Lower Connellsville	59	13, 160	-------	2, 575, 613	67. 5	1, 740, 414	9, 546, 128	5. 48
Pittsburgh	8	2, 977	-------	371, 561	57. 8	214, 925	1, 433, 880	6. 67
Upper Connellsville	11	1, 549	-------	417, 120	59. 2	246, 806	1, 835, 684	7. 44
Other districts [c]	14	3, 895	67	974, 463	63. 2	616, 342	3, 914, 113	6. 35
	167	38, 593	67	10, 416, 729	65. 6	6, 839, 980	38, 091, 586	5. 57
Grand total	180	41, 747	433	20, 780, 521	67. 3	13, 991, 892	74, 794, 560	5. 35
1923								
By-product:								
Eastern Pennsylvania [a]	5	844	-------	3, 463, 148	71. 8	2, 486, 464	17, 829, 569	7. 17
Western Pennsylvania [d]	7	2, 250	366	9, 944, 804	67. 4	6, 699, 283	25, 690, 680	3. 83
	12	3, 094	366	13, 407, 952	68. 5	9, 185, 747	43, 520, 249	4. 74
Beehive:								
Allegheny Mountain and Allegheny Valley	7	698	-------	308, 248	64. 2	198, 042	1, 391, 601	7. 03
Connellsville	66	15, 341	-------	11, 411, 725	66. 4	7, 580, 817	44, 079, 103	5. 81
Lower Connellsville	56	12, 557	-------	8, 739, 859	65. 4	5, 719, 608	32, 312, 919	5. 65
Pittsburgh	11	3, 381	-------	1, 902, 126	58. 9	1, 142, 129	6, 027, 389	5. 28
Upper Connellsville	12	1, 702	-------	778, 367	65. 3	508, 654	3, 274, 688	6. 44
Other districts [c]	13	3, 899	68	2, 037, 167	63. 3	1, 289, 289	7, 838, 242	6. 08
	165	37, 578	68	25, 177, 492	65. 3	16, 438, 539	94, 923, 942	5. 77
Grand total	177	40, 672	434	38, 585, 444	66. 4	25, 624, 286	138, 444, 191	5. 40

[a] Includes plants at Bethlehem, Steelton, Lebanon, Chester, and Swedeland.

[b] Includes plants at Glassport, Franklin, Rosedale, Clairton, Farrell, Dunbar, Pittsburgh, and Midland.

[c] Includes Bedford, Clearfield, Huntingdon, Jefferson, and parts of Indiana and Westmoreland Counties.

[d] Includes plants at Glassport, Johnstown, Clairton, Farrell, Dunbar, Pittsburgh, and Midland.

TABLE 16.—*Coke shipped from the Connellsville and Lower Connellsville districts, Pa., 1915, 1918, and 1920–1923, in net tons* [a]

Month	1915	1918	1920	1921	1922	1923
January	940, 781	1, 021, 055	1, 082, 289	735, 897	377, 003	1, 046, 630
February	1, 045, 739	991, 871	967, 122	552, 568	397, 537	1, 048, 425
March	1, 258, 559	1, 436, 821	1, 110, 550	361, 646	584, 497	1, 292, 435
April	1, 268, 292	1, 459, 248	799, 578	198, 966	377, 433	1, 270, 355
May	1, 310, 639	1, 532, 634	749, 537	186, 256	247, 145	1, 342, 545
June	1, 486, 845	1, 438, 700	796, 698	130, 324	276, 304	1, 306, 750
July	1, 618, 199	1, 578, 130	778, 345	92, 880	283, 472	1, 196, 660
August	1, 657, 203	1, 492, 065	909, 270	158, 250	371, 499	1, 144, 790
September	1, 683, 414	1, 423, 236	879, 297	188, 664	451, 240	1, 005, 200
October	1, 851, 938	1, 410, 403	921, 753	257, 499	628, 333	914, 800
November	1, 873, 405	1, 136, 355	889, 173	303, 532	799, 087	781, 690
December	1, 926, 202	1, 160, 072	854, 615	405, 935	872, 950	754, 060
	17, 921, 216	16, 080, 590	10, 738, 227	3, 572, 417	5, 666, 500	13, 104, 340

[a] Statistics from the Weekly Courier, Connellsville, Pa.

TABLE 17.—*By-product and beehive coke produced in West Virginia, 1922–23, by districts*

District	Plants	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens	
		Built	Under construction				Total	Per ton
1922								
By-product:								
Fairmont, Benwood, and Follansbee	3	[a] 274	[b] 37	757,877	66.2	501,894	$3,074,934	$6.13
Beehive:								
Flat Top	12	1,944	-------	134,302	61.0	81,929	469,360	5.73
Tug River	1	2,137	-------	-------	-------	-------	-------	-------
Kanawha	4	583	-------	95,034	60.3	57,315	426,787	7.45
New River	12	1,198	-------	163,667	58.8	96,181	874,976	9.10
Upper Monongahela and Panhandle	21	1,776	-------	263,620	59.2	156,094	1,063,554	6.81
Upper Potomac and Tygarts Valley	6	607	-------	38,219	68.9	26,331	202,776	7.70
	56	8,245	-------	694,842	60.1	417,850	3,037,453	7.27
Grand total	59	8,519	37	1,452,719	63.3	919,744	6,112,387	6.65
1923								
By-product:								
Fairmont, Benwood, Follansbee, and Weirton	4	[c] 311	-------	1,400,864	67.2	940,866	5,345,432	5.68
Beehive:								
Flat Top	12	1,944	-------	256,496	58.1	148,954	1,019,571	6.84
Tug River	1	2,137	-------	-------	-------	-------	-------	-------
Kanawha	4	583	-------	264,025	62.1	163,936	1,104,403	6.74
New River	11	1,188	-------	367,255	59.2	217,255	1,930,697	8.89
Upper Monongahela and Panhandle	20	1,596	-------	349,278	60.2	210,384	1,206,197	5.73
Upper Potomac and Tygarts Valley	6	607	-------	117,928	69.0	81,380	497,416	6.11
	54	8,055	-------	1,354,982	60.7	821,909	5,758,284	7.01
Grand total	58	8,366	-------	2,755,846	64.0	1,762,775	11,103,716	6.30

[a] 154 Koppers and 120 Semet-Solvay ovens.
[b] Koppers ovens.
[c] 191 Koppers and 120 Semet-Solvay ovens.

TABLE 18.—*By-product and beehive coke produced in Ohio, 1922–23, by districts*

District	Plants	Ovens		Coal used (net tons)	Yield of coke from coal (per cent)	Coke produced (net tons)	Value of coke at ovens	
		Built	Under construction				Total	Per ton
1922								
By-product:								
Canton and Cleveland	4	531	-------	2,276,725	71.2	1,621,711	$12,795,244	$7.89
Youngstown	3	533	-------	2,536,828	65.8	1,669,522	9,797,132	5.87
Other districts [a]	5	494	-------	2,319,805	69.8	1,620,437	9,794,761	6.04
	12	1,558	-------	7,133,358	68.9	4,911,670	32,387,137	6.59
Beehive	2	205	-------	153,034	65.0	99,468	713,186	7.17
Grand total	14	1,763	-------	7,286,392	68.8	5,011,138	33,100,323	6.61
1923								
By-product:								
Canton and Cleveland	4	531	-------	3,096,778	69.0	2,138,014	14,628,530	6.84
Youngstown	3	594	-------	3,168,680	65.9	2,090,220	13,832,569	6.62
Other districts [a]	5	494	84	3,024,977	69.3	2,095,576	12,251,183	5.85
	12	1,619	84	9,290,435	68.1	6,323,810	40,712,282	6.44
Beehive	2	205	-------	230,455	65.0	149,796	([b])	([b])
Grand total	14	1,824	84	9,520,890	68.0	6,473,606	([b])	([b])

[a] Includes plants at Dover, Ironton, Lorain, Portsmouth, and Toledo.
[b] Survey not at liberty to publish figures.

NUMBER AND TYPE OF OVENS

TABLE 19.—*By-product coke ovens built and under construction in the United States at end of each year, 1920–1923*

State	1920		1921		1922		1923	
	Built	Under construction	Built	Under construction	Built	Under construction	Built	Under construction
Alabama	1,081	90	1,141	30	1,196	------	1,196	------
Colorado	120	------	120	------	120	------	120	------
Illinois	794	100	894	5	899	------	899	------
Indiana	1,216	------	1,213	------	1,213	------	1,213	------
Kentucky	108	------	108	------	108	------	108	------
Maryland	300	------	300	------	300	------	300	------
Massachusetts	400	------	400	------	400	------	400	------
Michigan	389	------	390	------	390	------	390	32
Minnesota	220	------	220	------	220	------	220	------
Missouri	56	8	64	------	64	------	64	------
New Jersey	315	------	252	------	252	------	252	------
New York	732	------	732	------	692	------	598	114
Ohio	1,558	------	1,558	------	1,558	------	1,619	84
Pennsylvania	3,006	148	3,154	------	3,154	366	3,094	366
Rhode Island	40	------	40	------	40	------	40	------
Tennessee	24	------	24	------	24	------	24	------
Utah	------	------	------	------	------	------	------	33
Washington	20	------	20	------	20	------	20	------
West Virginia	274	------	274	------	274	37	311	------
Wisconsin	228	50	238	50	288	------	288	------
	10,881	396	11,142	85	11,212	403	11,156	629

TABLE 20.—*Beehive coke ovens in the United States at the end of each year, 1915, 1918, and 1920–1923*

State	1915	1918	1920	1921	1922	1923	
						Built	Under construction
Alabama	8,568	8,586	8,482	6,717	6,460	6,199	------
Colorado	3,573	2,724	1,793	1,758	1,758	1,758	------
Georgia	201	201	151	151	151	151	------
Kansas	2	2	------	------	------	------	------
Kentucky	1,097	1,077	855	855	795	795	------
Montana	112	------	------	------	------	------	------
New Mexico	1,030	1,154	1,030	1,030	1,030	1,030	------
Ohio	321	272	222	205	205	205	------
Oklahoma	50	304	300	300	300	300	------
Pennsylvania	53,112	48,588	44,569	39,806	38,593	37,578	68
Tennessee	2,302	2,328	1,848	1,848	1,822	1,767	------
Utah	726	819	819	819	819	819	------
Virginia	5,229	4,042	3,906	3,474	3,372	3,284	------
Washington	331	408	407	408	408	408	------
West Virginia	16,228	14,130	10,916	8,643	8,245	8,055	------
Wisconsin	228	------	------	------	------	------	------
	93,110	84,635	75,298	66,014	63,958	62,349	68

TABLE 21.—*Coke ovens completed and abandoned and total number in existence and under construction at the end of 1923*

State	Plants in existence	Ovens						
		New [a]		Abandoned during year	In existence Dec. 31		Under construction Dec. 31	
		Number	Capacity per day (net tons of coke)		Number	Capacity per day (net tons of coke)	Number	Capacity per day (net tons of coke)
By-product								
Alabama	7				1,196	13,723		
Colorado	1				120	1,680		
Illinois	7				899	11,143		
Indiana	6				1,213	15,357		
Kentucky	1				108	1,400		
Maryland	1				300	4,667		
Massachusetts	1				400	1,750		
Michigan	3				390	4,760	32	660
Minnesota	3				220	2,283		
Missouri	1				64	813		
New Jersey	2				252	2,418		
New York	4			[b] 94	598	5,248	114	1,950
Ohio	12				1,619	19,916	84	1,410
Pennsylvania	12			60	3,094	31,203	366	5,300
Rhode Island	1				40	510		
Tennessee	1				24	336		
Utah							33	723
Washington	1				20	85		
West Virginia	4	37	665		311	3,055		
Wisconsin	2				288	3,100		
	70	[c] 37	[c] 665	154	11,156	123,447	629	10,043
Beehive								
Alabama	21		([d])	351	6,199	([d])		([d])
Colorado	8				1,758			
Georgia	1				151			
Kentucky	4				795			
New Mexico	3				1,030			
Ohio	2				205			
Oklahoma	2				300			
Pennsylvania	165	72		1,846	37,578		68	
Tennessee	11			55	1,767			
Utah	1				819			
Virginia	14			60	3,284			
Washington	5				408			
West Virginia	54			178	8,055			
	291	[e] 72	([d])	2,490	62,349	([d])	68	([d])

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[a] Represents new construction. Does not include ovens repaired and put into commission.
[b] Being replaced by new ovens of different type.
[c] Excludes 61 old ovens, capacity 1,019 tons, repaired and put into commission.
[d] Data not available.
[e] Excludes 338 old ovens repaired and put into commission.

TABLE 22.—*By-product coke plants in the United States, December 31, 1923*

State	Town	Name of company owning plant	Type of plant[a]	Number of ovens	Type of oven	Year put in operation[b]
Alabama	Alabama City	Gulf States Steel Co.	F	37	Koppers	1917
	Birmingham	Alabama By-Products Corporation.	M	75	do	1920–1923
	do	Sloss Sheffield Steel & Iron Co.	F	120	Semet-Solvay	1920
	Ensley	Semet-Solvay Co.	F	240	do	1898–1902
	Fairfield	Tennessee Coal, Iron & R. R. Co.	F	434	Koppers	1912–1920
	Tuscaloosa	Central Iron & Coal Co.	F	60	Semet-Solvay	1906–1914
	Woodward	Woodward Iron Co.	F	170	Koppers	1911–1922
	do	do	F	60	Wilputte	1917
Colorado	Pueblo	Colorado Fuel & Iron Co.	F	120	Koppers	1918
Illinois	Chicago	Chicago By-Product Coke Co.	M	105	do	1921–22
	Granite City	St. Louis Coke & Iron Co.	F	80	Roberts	1921
	Joliet	Illinois Steel Co.	F	280	Koppers	1908–9
	Lockport	Coal Products Manufacturing Co.	M	18	Wilputte	1914
	do	do	M	35	Koppers	1912
	South Chicago	By-Products Coke Corporation.	M	280	Semet-Solvay	1905–1915
	do	International Harvester Co.	F	88	Wilputte	1919
	Waukegan	North Shore Gas Co.	M	13	Semet-Solvay	1912
Indiana	Gary	Illinois Steel Co.	F	700	Koppers	1911–1918
	Indiana Harbor.	Inland Steel Co.	F	130	do	1913–1917
	do	Youngstown Sheet & Tube Co.	F	120	Semet-Solvay	1919
	Indianapolis	Citizens Gas Co.	M	100	United-Otto	1909–1913
	do	do	M	41	Semet-Solvay	1914
	do	do	M	40	Wilputte	1919
	Muncie	Central Indiana Gas Co.	M	22	Klönne	1912
	Terre Haute	Indiana Coke & Gas Co.	M	30	Gas Machinery	1916
	do	do	M	30	Koppers	1919
Kentucky	Ashland	Ashland By-Products Coke Co.	F	108	Semet-Solvay	1913–1916
Maryland	Sparrows Point	Bethlehem Steel Co.	F	300	Koppers	1914–1919
Massachusetts	Everett	New England Fuel & Transportation Co.	M	400	United-Otto	1899
Michigan	Dearborn	Ford Motor Co.	F	120	Semet-Solvay	1919
	Detroit	Solvay Process Co.	M	216	do	1901–1917
	Wyandotte	Michigan Alkali Co.	M	54	United-Otto	1902–1916
Minnesota	Duluth	Minnesota Steel Co.	F	90	Koppers	1915–16
	St. Paul	Minnesota By-Product Coke Co.	M	65	do	1918
	West Duluth	Zenith Furnace Co.	F	65	United-Otto	1904–1916
Missouri	St. Louis	Laclede Gas Light Co.	M	56	Koppers	1915
	do	do	M	8	Piette	1921
New Jersey	Camden	Camden Coke Co.	M	50	United-Otto	1903–1906
	do	do	M	37	Koppers	1921
	Kearny	Seaboard By-Product Coke Co.	M	165	do	1917–1919
New York	Buffalo	Donner Union Coke Corporation.	F	150	do	1920
	do	Wickwire Spencer Steel Corporation.	F	60	Semet-Solvay	1917
	Geneva	Empire Gas & Electric Co.	M	46	do	1904–1909
	Lackawanna	Bethlehem Steel Co.	F	60	do	1920
	do	do	F	282	Rothberg	--------
Ohio	Canal Dover	Hanna Furnace Co.	F	24	Roberts	1916
	Canton	United Alloy Steel Corporation.	F	47	Koppers	1916
	Cleveland	American Steel & Wire Co.	F	180	do	1918
	do	McKinney Steel Co.	F	204	do	1916
	do	Otis Steel Co.	F	100	Semet-Solvay	1910–1915
	East Youngstown.	Youngstown Sheet & Tube Co.	F	306	Koppers	1916–1918
	Ironton	Ironton By-Product Coke Co.	F	60	Semet-Solvay	1918
	Lorain	National Tube Co.	F	208	Koppers	1918

[a] F, "Furnace plants," or plants associated with iron furnaces and steel works. M, "Nonfurnace plants" or "other plants" (see Tables 9–11), including merchant plants, plants associated with industries other than iron and steel, and plants supplying gas under contract for city use.

[b] The first and last years are given for those plants that have two or more installations.

TABLE 22.—*By-product coke plants in the United States, December 31, 1923*—Con.

State	Town	Name of company owning plant	Type of plant	Number of ovens	Type of oven	Year put in operation
Ohio	Portsmouth	Portsmouth By-Product Coke Co.	F	108	Semet-Solvay	1917
	Toledo	Toledo Furnace Co	F	94	Koppers	1916
	Youngstown	Republic Iron & Steel Co.	F	204	do	1914–1923
	do	Youngstown Sheet & Tube Co.	F	84	do	1917
Pennsylvania	Bethlehem	Bethlehem Steel Co	F	424	do	1915–16
	Chester	Philadelphia Suburban Gas & Electric Co.	M	40	Semet-Solvay	1904
	Clairton	Carnegie Steel Co	F	768	Koppers	1918–19
	Dunbar	American Manganese Manufacturing Co.	F	110	Semet-Solvay	1896–1903
	Farrell	Carnegie Steel Co	F	212	Otto-Hoffmann	1903
	Glassport	Allegheny By - Product Coke Co.	M	120	United-Otto	1897
	Johnstown	Bethlehem Steel Co	F	150	Otto-Hoffmann	1895–1907
	do	do	F	92	Koppers	1915
	do	do	F	310	Cambria	1918–1921
	do	do	F	88	Semet-Solvay	1921
	Lebanon	do	F	90	do	1904–1921
	Midland	Pittsburgh Crucible Steel Co.	F	100	Koppers	1920
	Pittsburgh	Jones & Laughlin Steel Co.	F	300	do	1919–20
	Steelton	Bethlehem Steel Co	F	120	Semet-Solvay	1907
	do	do	F	60	Koppers	1918
	Swedeland	Rainey-Wood Coke Co	F	110	do	1919
Rhode Island	Providence	Providence Gas Co	M	40	do	1919
Tennessee	Altonpark	Chattanooga Coke & Gas Co.	M	24	Semet-Solvay	1915
Washington	Seattle	Seattle Lighting Co	M	20	Klönne	1914
West Virginia	Benwood	National Tube Co	F	120	Semet-Solvay	1898–1901
	Fairmont	Domestic Coke Corporation.	M	60	Koppers	1920
	Follansbee	Wheeling Steel Corporation.	F	94	do	1917
	Weirton	Weirton Steel Co	F	37	do	1923
Wisconsin	Mayville	Youngstown Sheet & Tube Co.	F	108	Otto-Hoffmann	1914–1917
	Milwaukee	Milwaukee Coke & Gas Co.	M	80	Semet-Solvay	1901–1906
	do	do	M	100	Koppers	1921–22

TABLE 23.—*By-product ovens under construction in the United States, December 31, 1923*

State	Town	Name of company owning plant	Number of ovens	Type of oven	Date of operation
Michigan	Battle Creek	Battle Creek Gas Co	11	Koppers	January, 1924.
	Dearborn	Ford Motor Co	2	Piron	October, 1924.
	Zilwaukee	Consumers Power Co	19	Koppers	May, 1924.
New York	Lackawanna	Bethlehem Steel Co	114	do	June, 1924.
Ohio	Painesville	Diamond Alkali Co	37	do	May, 1924.
	Warren	Trumbull-Cliffs Furnace Co	47	do	July, 1924.
Pennsylvania	Clairton	Carnegie Steel Co	366	do	June, 1924.
Utah	Ironton	Columbia Steel Corporation	33	do	April, 1924.

TABLE 24.—*By-product ovens of each type in the United States at the end of the year in 1922 and 1923*

State	Koppers	Semet-Solvay	United Otto [a]	Rothberg	Gas Machinery	Roberts	Klönne	Wilputte	Piette	Cambria-Belgian	Total
1922											
Alabama	716	420						60			1,196
Colorado	120										120
Illinois	420	293				80		106			899
Indiana	860	161	100		30		22	40			1,213
Kentucky		108									108
Maryland	300										300
Massachusetts			400								400
Michigan		336	54								390
Minnesota	155		65								220
Missouri	56								8		64
New Jersey	202		50								252
New York	150	166	94	282							692
Ohio	1,266	268				24					1,558
Pennsylvania	1,854	448	542							310	3,154
Rhode Island	40										40
Tennessee		24									24
Washington							20				20
West Virginia	154	120									274
Wisconsin	100	80	108								288
	6,393	2,424	1,413	282	30	104	42	206	8	310	11,212
1923											
Alabama	716	420						60			1,196
Colorado	120										120
Illinois	420	293				80		106			899
Indiana	860	161	100		30		22	40			1,213
Kentucky		108									108
Maryland	300										300
Massachusetts			400								400
Michigan		336	54								390
Minnesota	155		65								220
Missouri	56								8		64
New Jersey	202		50								252
New York	150	166		282							598
Ohio	1,327	268				24					1,619
Pennsylvania	1,854	448	482							310	3,094
Rhode Island	40										40
Tennessee		24									24
Washington							20				20
West Virginia	191	120									311
Wisconsin	100	80	108								288
	6,491	2,424	1,259	282	30	104	42	206	8	310	11,156

[a] Includes the Otto-Hoffmann and Schniewind types.

CAPACITY OF BY-PRODUCT OVENS

TABLE 25.—*Estimated annual potential production of coke and coal required for charge, in millions of net tons, of by-product coke ovens in the United States, 1918, 1920, 1922, and 1923, when operated at different percentages of maximum capacity*

Percentage of maximum capacity	1918		1920		1922				1923			
					Ovens completed Dec. 31		Including ovens under construction		Ovens completed Dec. 31 [b]		Including ovens under construction	
	Coke	Coal [a]	Coke	Coal [a]	Coke	Coal [a]	Coke	Coal [a]	Coke	Coal [a]	Coke	Coal [a]
100	33.7	48.1	42.8	61.2	43.8	62.6	45.9	65.6	45.1	64.4	48.7	69.6
90	30.3	43.3	38.5	55.0	39.4	56.3	41.3	59.0	40.6	58.0	43.8	62.6
85	28.6	40.9	36.4	52.0	37.2	53.2	39.0	55.8	38.3	54.7	41.4	59.2
75	25.3	36.1	32.1	45.9	32.9	47.0	34.4	49.2	33.8	48.3	36.5	52.2
50	16.8	24.0	21.4	30.6	21.9	31.3	23.0	32.8	22.6	32.2	24.4	34.8

[a] Coal for charge estimated on basis of 70 per cent yield in coke.

[b] The indicated increase in capacity from Dec. 31, 1922, to Dec. 31, 1923 is due not to the construction of new ovens, but to an upward revision of the rated capacity of certain plants as reported by the operators to the Geological Survey.

TABLE 26.—*Percentage of maximum capacity produced by by-product coke operators, 1920–1923, by months*

	1920	1921	1922	1923		1920	1921	1922	1923
January	72.0	62.3	50.4	83.2	August	78.1	37.5	48.2	86.5
February	74.1	57.3	53.4	85.0	September	80.7	39.7	62.3	85.9
March	77.4	48.6	57.4	87.2	October	82.8	45.9	75.4	82.8
April	67.2	42.7	59.2	88.7	November	77.8	48.4	81.2	81.1
May	68.7	43.4	68.1	89.1	December	69.5	49.7	82.2	80.1
June	73.4	39.4	69.2	87.6					
July	75.8	35.1	66.7	87.2	The year	74.8	45.8	64.6	85.4

QUANTITY AND COST OF COAL CHARGED

TABLE 27.—*Total quantity and value at ovens of coal used in the manufacture of coke in the United States, 1922–23, by States*

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Per ton of coal	Net tons	Cost
1922					
By-product plants					
Alabama	5,115,981	$12,630,514	$2.47	1.46	$3.61
Colorado	528,956	2,382,792	4.50	1.45	6.53
Illinois	2,876,987	17,019,771	5.92	1.45	8.58
Indiana	5,509,297	31,404,367	5.70	1.38	7.87
Kentucky	629,012	2,690,701	4.28	1.38	5.91
Michigan	1,578,357	8,914,007	5.65	1.38	7.80
Minnesota	688,007	4,670,302	6.79	1.49	10.12
New York	2,208,162	12,357,964	5.60	1.48	8.29
Ohio	7,133,358	35,969,214	5.04	1.45	5.86
Pennsylvania	10,363,792	39,204,401	3.78	1.45	5.48
Tennessee	37,061	142,153	3.84	1.35	5.18
Washington	9,390	51,673	5.50	1.67	9.19
West Virginia	757,877	3,081,474	4.07	1.51	6.15
Maryland, Massachusetts, Missouri, New Jersey, Rhode Island, and Wisconsin	3,616,433	23,496,392	6.50	1.41	9.17
	41,052,670	194,015,725	4.73	1.44	6.81
Beehive plants					
Alabama	509,661	1,306,423	2.56	1.66	4.28
Colorado	183,627	629,865	3.43	1.54	5.28
Georgia	16,178	68,096	4.21	1.83	7.70
Kentucky	53,660	167,143	3.11	1.76	5.47
New Mexico	141,340	397,165	2.81	1.61	4.52
Ohio	153,034	662,471	4.33	1.54	6.67
Pennsylvania	10,416,729	26,787,513	2.57	1.52	3.91
Tennessee	174,945	537,119	3.07	2.02	6.20
Utah	299,499	300,414	1.00	1.74	1.74
Virginia	601,528	1,503,529	2.50	1.59	3.98
Washington	40,825	215,965	5.29	1.57	8.31
West Virginia	694,842	2,126,419	3.06	1.66	5.08
	13,285,868	34,702,122	2.61	1.55	4.05
1923					
By-product plants					
Alabama	6,408,843	18,954,008	2.95	1.45	4.28
Colorado	653,139	(a)	(a)	1.46	--------
Illinois	4,589,863	26,507,580	5.78	1.47	8.50
Indiana	7,143,914	41,284,147	5.77	1.41	8.14
Maryland	1,173,062	(a)	(a)	1.36	--------
Massachusetts	797,833	(a)	(a)	1.44	--------
Michigan	2,286,754	13,245,431	5.79	1.39	8.05
Minnesota	999,924	6,741,767	6.74	1.43	9.64
New Jersey	1,207,605	(a)	(a)	1.34	--------
New York	2,607,867	13,851,717	5.31	1.46	7.75
Ohio	9,290,435	44,973,898	4.84	1.46	7.05
Pennsylvania	13,407,952	50,514,662	3.77	1.46	5.50
Tennessee	171,703	601,278	3.50	1.38	4.83
Washington	54,811	298,248	5.44	1.76	9.57
West Virginia	1,400,864	5,638,695	4.03	1.49	6.00
Kentucky, Missouri, Rhode Island, and Wisconsin	2,081,008	12,533,360	6.02	1.40	8.43
Undistributed	------------	23,256,199	5.27	--------	--------
	54,275,577	258,400,990	4.76	1.44	6.85

[a] Included under "Undistributed."

TABLE 27.—*Total quantity and value at ovens of coal used in the manufacture of coke in the United States, 1922–23, by States*—Continued

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Per ton of coal	Net tons	Cost
1923					
Beehive plants					
Alabama	464, 160	$1, 299, 385	$2. 80	1. 72	$4. 82
Colorado	306, 836	(a)	(a)	1. 54	--------
Georgia	24, 161	99, 788	4. 13	1. 93	7. 97
Kentucky	230, 539	572, 665	2. 48	1. 84	4. 56
Ohio	230, 455	(a)	(a)	1. 54	--------
Pennsylvania	25, 177, 492	62, 220, 652	2. 47	1. 54	3. 80
Tennessee	330, 831	961, 119	2. 91	1. 84	5. 35
Utah	403, 055	1, 309, 926	3. 25	1. 72	5. 59
Virginia	1, 241, 159	3, 453, 525	2. 78	1. 61	4. 48
Washington	55, 730	312, 944	5. 61	1. 47	8. 25
West Virginia	1, 354, 982	3, 599, 475	2. 66	1. 65	4. 39
New Mexico and Oklahoma	264, 966	1, 073, 471	4. 05	1. 94	7. 86
Undistributed	----------	2, 134, 160	3. 97	----------	--------
	30, 084, 366	77, 037, 110	2. 56	1. 55	3. 97

[a] Included under "Undistributed."

TABLE 28.—*Average cost per ton of coal charged into by-product coke ovens, 1914–1923*

State	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Alabama	$1. 57	$1. 65	$1. 89	$2. 54	$3. 29	$3. 35	$4. 10	$3. 29	$2. 47	$2. 95
Illinois	2. 82	2. 87	2. 93	3. 81	4. 63	4. 73	6. 49	5. 90	5. 92	5. 78
Indiana	2. 84	2. 94	3. 05	3. 87	4. 50	4. 63	5. 92	5. 89	5. 70	5. 77
Kentucky	1. 51	1. 47	1. 52	2. 55	3. 34	3. 40	4. 84	4. 20	4. 28	(a)
Michigan	2. 43	2. 38	2. 48	3. 63	4. 51	4. 60	7. 03	5. 77	5. 65	5. 79
Minnesota	2. 75	2. 72	2. 94	4. 01	5. 31	4. 33	6. 50	7. 12	6. 79	6. 74
New York	2. 51	2. 50	2. 73	4. 33	4. 46	4. 34	6. 20	5. 86	5. 60	5. 31
Ohio	1. 96	1. 88	2. 56	4. 36	3. 98	3. 85	5. 75	4. 94	5. 04	4. 84
Pennsylvania	2. 02	2. 01	2. 47	3. 29	3. 74	2. 99	3. 91	3. 39	3. 78	3. 77
Tennessee	-------	1. 64	1. 66	2. 08	3. 59	3. 64	4. 30	3. 84	3. 84	3. 50
Washington	3. 31	3. 34	3. 38	3. 87	5. 72	5. 89	6. 63	6. 53	5. 50	5. 44
West Virginia	1. 99	1. 88	2. 00	3. 30	3. 57	3. 18	4. 82	3. 89	4. 07	4. 03
Average	2. 31	2. 33	2. 60	3. 70	4. 23	3. 96	5. 40	4. 84	4. 73	4. 76
Cost of coal per ton of coke	3. 19	3. 24	3. 62	5. 20	6. 00	5. 65	7. 73	7. 03	6. 81	6. 85

[a] Survey not at liberty to publish.

TABLE 29.—*Cost of coal and value of all products per ton of coke produced, 1913–1923*

[All figures reduced to value per ton of coke produced]

Year	By-product coke					Beehive coke		
	Value of coke per ton[a]	Value of all by-products	Total value of products	Cost of coal	Excess, products over coal	Value of coke per ton[a]	Cost of coal	Excess, coke over coal
1913	$3. 82	$1. 41	$5. 23	$3. 27	$1. 96	$2. 39	$1. 75	$0. 64
1914	3. 39	1. 65	5. 04	3. 19	1. 85	2. 15	1. 67	. 48
1915	3. 45	2. 19	5. 64	3. 24	2. 40	2. 07	1. 61	. 46
1916	3. 95	3. 25	7. 20	3. 62	3. 58	2. 69	1. 96	. 73
1917	6. 18	3. 01	9. 19	5. 20	3. 99	4. 81	3. 17	1. 64
1918	7. 42	3. 07	10. 49	6. 00	4. 49	6. 21	3. 65	2. 56
1919	6. 37	2. 72	9. 09	5. 65	3. 44	5. 15	3. 39	1. 76
1920	10. 15	3. 40	13. 55	7. 73	5. 82	7. 94	4. 90	3. 04
1921	5. 95	3. 46	9. 41	7. 03	2. 38	5. 45	3. 82	1. 63
1922	6. 59	3. 32	9. 91	6. 81	3. 10	5. 84	4. 05	1. 79
1923	6. 85	3. 48	10. 33	6. 85	3. 46	5. 98	3. 97	2. 01

[a] Includes operators' statements of the value of coke consumed by them in associated enterprises but not sold, except that in 1918 and 1920 the value of such coke was estimated by the Geological Survey for each State at the average value for that State of the part of the product reported sold.

PREPARATION AND SOURCE OF COAL CHARGED

TABLE 30.—*Coal used in the manufacture of by-product and beehive coke in the United States, 1920–1923, in net tons*

State	1920	1921	1922	1923		
				Unwashed	Washed	Total
By-product ovens:						
Alabama	4, 542, 279	3, 476, 923	5, 115, 981	112, 561	6, 296, 282	6, 408, 843
Colorado	730, 870	417, 112	528, 956		653, 139	653, 139
Illinois	3, 090, 862	1, 952, 358	2, 876, 987	4, 353, 106	236, 757	4, 589, 863
Indiana	6, 355, 846	4, 342, 467	5, 509, 297	6, 670, 980	472, 934	7, 143, 914
Kentucky	671, 866	257, 854	629, 012	582, 385		582, 385
Maryland	953, 404	395, 526	799, 630	1, 173, 062		1, 173, 062
Massachusetts	630, 365	399, 935	606, 589	797, 833		797, 833
Michigan	1, 902, 224	1, 103, 524	1, 578, 357	2, 286, 754		2, 286, 754
Minnesota	942, 869	630, 173	688, 007	999, 924		999, 924
Missouri	(a)	(a)	(a)	(a)		(a)
New Jersey	1, 012, 562	1, 064, 960	1, 084, 781	1, 207, 605		1, 207, 605
New York	1, 504, 902	1, 098, 014	2, 208, 162	2, 277, 634	330, 233	2, 607, 867
Ohio	8, 151, 987	4, 375, 992	7, 133, 358	9, 290, 435		9, 290, 435
Pennsylvania	11, 325, 505	7, 865, 395	10, 363, 792	12, 105, 876	1, 302, 076	13, 407, 952
Rhode Island	(a)	(a)	(a)	(a)		(a)
Tennessee	183, 200	79, 911	37, 061		171, 703	171, 703
Washington	44, 594	43, 570	9, 390		54, 811	54, 811
West Virginia	626, 196	277, 345	757, 877	1, 400, 864		1, 400, 864
Wisconsin	(a)	(a)	(a)	(a)		(a)
Combined States	1, 535, 465	932, 052	1, 125, 433	1, 498, 623		1, 498, 623
	44, 204, 996	28, 713, 111	41, 052, 670	44, 757, 642	9, 517, 935	54, 275, 577
Beehive ovens:						
Alabama	1, 488, 755	223, 119	509, 661	66, 925	397, 235	464, 160
Colorado	422, 244	123, 828	183, 627	14, 292	292, 544	306, 836
Georgia	29, 804	12, 708	16, 178		24, 161	24, 161
Kentucky	447, 418	161, 507	53, 660	230, 539		230, 539
New Mexico	(a)	(a)	141, 340		(a)	(a)
Ohio	139, 144	99, 787	153, 034	230, 455		230, 455
Oklahoma					(a)	(a)
Pennsylvania	24, 344, 157	6, 722, 491	10, 416, 729	22, 312, 188	2, 865, 304	25, 177, 492
Tennessee	310, 583	54, 328	174, 945		330, 831	330, 831
Utah	(a)	(a)	299, 499	403, 055		403, 055
Virginia	1, 645, 253	442, 038	601, 528	992, 814	248, 345	1, 241, 159
Washington	47, 876	6, 291	40, 825		55, 730	55, 730
West Virginia	2, 283, 737	343, 226	694, 842	1, 314, 182	40, 800	1, 354, 982
Combined States	826, 865	286, 123			264, 966	264, 966
	31, 985, 836	8, 475, 446	13, 285, 868	25, 564, 450	4, 519, 916	30, 084, 366

[a] Included under "Combined States."

TABLE 31.—*Coal consumed at beehive-coke plants, 1922–23, classified with respect to practice in crushing coal before charging, in net tons*

State and district	At plants practicing crushing [a]	At plants not practicing crushing	Total
1922			
Alabama	372,858	136,803	509,661
Colorado	183,627	----	183,627
Georgia	----	16,178	16,178
Kentucky	41,615	12,045	53,660
New Mexico	141,340	----	141,340
Ohio	----	153,034	153,034
Pennsylvania:			
Allegheny Mountain and Allegheny Valley district	174,167	3,701	177,868
Connellsville district	50,691	5,849,413	5,900,104
Lower Connellsville district	729,070	1,846,543	2,575,613
Pittsburgh district	371,561	----	371,561
Upper Connellsville district	364,598	52,522	417,120
Other districts	960,571	13,892	974,463
Total Pennsylvania	2,650,658	7,766,071	10,416,729
Tennessee	174,945	----	174,945
Utah	299,499	----	299,499
Virginia	601,528	----	601,528
Washington	16,202	24,623	40,825
West Virginia:			
Flat Top district	59,254	75,048	134,302
Kanawha district	95,034	----	95,034
New River district	163,667	----	163,667
Upper Monongahela district	249,116	14,504	263,620
Upper Potomac and Tygarts Valley district	19,426	18,793	38,219
Total West Virginia	586,497	108,345	694,842
Total United States	5,068,769	8,217,099	13,285,868
1923			
Alabama	369,822	94,338	464,160
Colorado	92,544	14,292	306,836
Georgia	----	24,161	24,161
Kentucky	230,539	----	230,539
New Mexico and Oklahoma	264,966	----	264,966
Ohio	----	230,455	230,455
Pennsylvania:			
Allegheny Mountain and Allegheny Valley district	115,929	192,319	308,248
Connellsville district	61,699	11,941,875	12,003,574
Lower Connellsville district	2,018,374	6,129,636	8,148,010
Pittsburgh district	1,551,768	350,358	1,902,126
Upper Connellsville district	502,014	276,353	778,367
Other districts	1,865,034	172,133	2,037,167
Total Pennsylvania	6,114,818	19,062,674	25,177,492
Tennessee	302,331	28,500	330,831
Utah	403,055	----	403,055
Virginia	1,241,159	----	1,241,159
Washington	55,730	----	55,730
West Virginia:			
Flat Top district	147,029	109,467	256,496
Kanawha district	264,025	----	264,025
New River district	172,338	194,917	367,255
Upper Monongahela district	86,487	36,639	123,126
Upper Potomac and Tygarts Valley district	327,307	16,773	344,080
Total West Virginia	997,186	357,796	1,354,982
Total United States	10,272,150	19,812,216	30,084,366

[a] Includes a small number of plants that reported charging slack or screenings.

TABLE 32.—*Coal used in the manufacture of by-product coke, 1922–23, by sources in net tons*

State in which coal was used	Coal produced in—						
	Alabama	Arkansas	Colorado	Illinois	Indiana	Kentucky	Oklahoma
1922							
Alabama	5,114,121	------	------	------	------	------	------
Colorado	------	------	528,956	------	------	------	------
Illinois	------	------	------	564,137	65,650	[a] 1,498,000	------
Indiana	------	------	------	268,119	400,585	[a] 1,140,000	------
Kentucky	------	------	------	------	------	521,596	------
Michigan	------	------	------	------	------	629,790	------
Minnesota	------	([b])	------	([b])	------	[a] 103,000	------
New Jersey	------	------	------	------	------	29,705	------
New York	------	------	------	------	------	626,913	------
Ohio	------	------	------	------	------	1,694,423	------
Pennsylvania	------	------	------	------	------	[a] 558,000	------
Missouri, Rhode Island, and Wisconsin	------	------	------	4,876	------	[a] 384,000	26,006
	5,114,121	([b])	528,956	[c] 840,132	466,235	7,185,427	26,006

State in which coal was used	Coal produced in—					Coal imported from England	Total [d]
	Pennsylvania	Tennessee	Virginia	Washington	West Virginia		
1922							
Alabama	------	------	------	------	------	------	5,114,121
Colorado	------	------	------	------	------	------	528,956
Illinois	38,563	------	------	------	710,468	------	2,876,818
Indiana	213,240	------	------	------	[a] 3,528,000	------	5,549,944
Kentucky	------	------	------	------	107,416	------	629,012
Maryland	259,413	------	------	------	522,089	18,128	799,630
Massachusetts	------	------	[a] 139,000	------	[a] 358,000	[a] 109,000	606,000
Michigan	181,496	------	------	------	767,071	------	1,578,357
Minnesota	[a] 343,000	------	------	------	238,846	------	[c] 688,446
New Jersey	201,366	------	444,426	------	238,979	170,305	1,084,781
New York	1,282,322	------	142,000	------	156,927	------	2,208,162
Ohio	3,371,822	------	30,350	------	2,036,743	------	7,133,338
Pennsylvania	[a] 7,950,000	------	------	------	[a] 1,856,000	------	10,364,000
Tennessee	------	37,061	------	------	------	------	37,061
Washington	------	------	------	9,390	------	------	9,390
West Virginia	359,184	------	------	------	398,693	------	757,877
Missouri, Rhode Island, and Wisconsin	43,345	------	25,150	------	[a] 570,000	71,857	1,125,234
	14,243,751	37,061	780,926	9,390	11,489,232	369,290	[d] 41,091,127

State in which coal was used	Coal produced in—						
	Alabama	Arkansas	Colorado	Illinois	Indiana	Kentucky	Oklahoma
1923							
Alabama	6,609,431	------	------	------	------	------	------
Colorado	------	------	702,369	------	------	------	------
Illinois	------	------	------	773,046	159,662	2,070,094	------
Indiana	------	------	------	473,322	556,458	1,450,984	------
Michigan	------	------	------	------	------	979,866	------
Minnesota	------	235	------	------	446	126,896	156
New York	------	------	------	------	------	217,089	------
Ohio	------	------	------	------	------	2,429,005	------
Kentucky, Missouri, Rhode Island, and Wisconsin	------	------	------	------	4,391	897,071	------
	6,609,431	235	702,369	1,246,368	720,957	8,171,005	156

[a] Estimated in part from incomplete reports.
[b] Small amount only, estimate for which is included in the total.
[c] Includes estimates for items not shown separately.
[d] Difference between these totals and those shown in Tables 2, etc., is due to changes in stock, loss of weight in handling, and other factors.

TABLE 32.—*Coal used in the manufacture of by-product coke, 1922–23, by sources, in net tons*—Continued

State in which coal was used	Coal produced in—					Coal imported from England	Total [d]
	Pennsylvania	Tennessee	Virginia	Washington	West Virginia		
1923							
Alabama	----------	----------	----------	----------	----------	----------	6, 609, 431
Colorado	----------	----------	----------	----------	----------	----------	702, 369
Illinois	22, 093	----------	----------	----------	1, 564, 968	----------	4, 589, 863
Indiana	568, 280	----------	108, 701	----------	3, 986, 169	----------	7, 143, 914
Maryland	637, 159	----------	----------	----------	535, 903	----------	1, 173, 062
Massachusetts	----------	----------	225, 166	----------	496, 712	75, 915	797, 793
Michigan	204, 977	----------	----------	----------	1, 101, 911	----------	2, 286, 754
Minnesota	527, 920	----------	4, 538	----------	339, 708	----------	999, 899
New Jersey	----------	----------	683, 817	----------	523, 788	----------	1, 207, 605
New York	2, 201, 959	----------	----------	----------	188, 818	----------	2, 607, 866
Ohio	5, 161, 864	----------	----------	----------	1, 696, 566	----------	9, 287, 435
Pennsylvania	11, 795, 831	----------	----------	----------	1, 612, 121	----------	13, 407, 952
Tennessee	----------	171, 703	----------	----------	----------	----------	171, 703
Washington	----------	----------	----------	54, 811	----------	----------	54, 811
West Virginia	933, 958	----------	----------	----------	466, 905	----------	1, 400, 863
Kentucky, Missouri, Rhode Island, and Wisconsin	80, 116	----------	79, 039	----------	1, 003, 445	15, 307	2, 079, 369
	22, 134, 157	171, 703	1, 101, 261	54, 811	13, 517, 014	91, 222	[d] 54, 520, 689

[d] Difference between these totals and those shown in Tables 2, etc., is due to changes in stock, loss of weight in handling, and other factors

YIELD OF COKE PER TON OF COAL

TABLE 33.—*Percentage yield of coke from coal in by-product and beehive ovens in the United States, 1920–1923*

State	1920		1921		1922		1923	
	By-product	Beehive	By-product	Beehive	By-product	Beehive	By-product	Beehive
Alabama	68. 8	59. 8	69. 1	59. 6	68. 3	60. 1	68. 4	57. 9
Colorado	70. 7	64. 6	68. 7	65. 7	68. 9	65. 0	68. 6	65. 0
Georgia	----------	55. 4	----------	54. 6	----------	54. 6	----------	52. 0
Illinois	69. 1	----------	67. 7	----------	68. 9	----------	69. 4	----------
Indiana	71. 6	----------	71. 2	----------	72. 5	----------	70. 6	----------
Kentucky	69. 5	60. 9	71. 9	61. 6	72. 6	56. 9	74. 5	54. 5
Maryland	71. 5	----------	73. 9	----------	73. 8	----------	73. 4	----------
Massachusetts	77. 4	----------	73. 5	----------	67. 1	----------	69. 4	----------
Michigan	73. 2	----------	70. 4	----------	72. 3	----------	72. 1	----------
Minnesota	71. 6	----------	69. 2	----------	67. 2	----------	69. 6	----------
Missouri	72. 0	----------	70. 8	----------	69. 3	----------	73. 9	----------
New Jersey	71. 7	----------	69. 5	----------	72. 9	----------	74. 3	----------
New Mexico	----------	54. 4	----------	71. 8	----------	62. 0	----------	51. 8
New York	69. 1	----------	68. 0	----------	67. 7	----------	68. 4	----------
Ohio	68. 9	62. 5	67. 8	62. 3	68. 9	65. 0	68. 1	65. 0
Oklahoma	----------	----------	----------	----------	----------	----------	----------	52. 1
Pennsylvania	68. 3	65. 3	67. 4	66. 4	69. 0	65. 6	68. 5	65. 3
Rhode Island	66. 3	----------	70. 0	----------	70. 0	----------	70. 0	----------
Tennessee	75. 9	52. 3	72. 2	51. 5	74. 1	49. 4	72. 3	54. 5
Utah	----------	56. 8	----------	57. 3	----------	57. 6	----------	57. 8
Virginia	----------	62. 5	----------	63. 5	----------	62. 9	----------	62. 4
Washington	58. 9	69. 2	54. 5	55. 6	59. 8	63. 8	56. 7	68. 2
West Virginia	71. 4	60. 4	67. 9	61. 0	66. 2	60. 1	67. 2	60. 7
Wisconsin	70. 0	----------	66. 5	----------	67. 8	----------	68. 8	----------
Average	69. 9	64. 1	68. 8	65. 3	69. 5	64. 5	69. 3	64. 4

COKE BREEZE

TABLE 34.—*Coke breeze recovered at coke plants in the United States, 1922–23, by States*

State	Yield (per cent of coal)	Produced		Used for steam raising		Used for other purposes by producer		Sold		Put in stock (net tons)	Wasted (net tons)
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
1922											
By-product ovens											
Alabama	4.2	212,601	$499,898	126,916	$268,041	11,908	$26,119	34,863	$127,430	32,273	5,564
Colorado	7.1	37,753	(a)	28,684	(a)	8,221	(a)	----------	----------	848	----------
Illinois	5.4	154,595	357,602	87,706	203,331	16,157	35,979	78,593	184,539	9,782	----------
Indiana	5.7	312,868	687,854	259,893	557,854	54,056	110,847	72,794	206,120	4,209	----------
Kentucky	2.4	15,309	21,892	----------	----------	----------	----------	13,584	19,536	----------	1,725
Maryland	1.4	11,078	(a)	----------	----------	3,243	(a)	2,961	(a)	4,874	----------
Massachusetts	6.3	38,367	(a)	18,366	(a)	1,206	(a)	11,448	(a)	----------	----------
Michigan	4.7	74,901	149,176	91,720	214,366	276	480	37,830	65,618	303	----------
Minnesota	9.1	62,450	122,061	36,399	71,890	3,191	3,560	29,576	58,412	2,102	709
New Jersey	5.5	59,952	(a)	45,025	(a)	239	(a)	14,936	(a)	----------	----------
New York	5.3	116,177	330,594	68,711	142,721	21,785	43,571	24,956	141,841	3,615	----------
Ohio	7.3	519,923	1,157,231	223,925	197,459	161,232	455,494	136,157	485,681	11,818	1,878
Pennsylvania	6.2	643,031	1,058,372	507,508	821,165	9,126	17,169	61,103	143,160	5,612	22,300
Tennessee	2.9	1,093	1,093	----------	----------	----------	----------	479	479	614	----------
Washington	10.9	1,026	1,026	1,488	1,488	4	4	16	56	----------	----------
West Virginia	6.8	51,507	70,608	16,161	11,867	3,063	2,411	1,090	1,812	----------	1,545
Missouri, Rhode Island, and Wisconsin	7.3	82,655	164,283	74,708	162,990	910	455	5,771	12,224	4,710	30
Undistributed	----------	----------	501,647	----------	269,741	----------	34,081	----------	136,491	----------	----------
	5.8	2,395,286	5,123,337	1,587,210	2,922,913	294,617	730,170	526,157	1,583,399	80,760	33,751
Beehive ovens											
Pennsylvania	[b]2.6	58,658	140,554	14,130	23,174	6,147	9,304	15,344	59,988	----------	[c]26,730
Tennessee	[b]2.1	3,136	7,965	2,443	6,170	----------	----------	----------	----------	----------	----------
Virginia	[b]1.2	3,222	13,857	----------	----------	----------	----------	2,498	11,982	----------	----------
West Virginia	[b]0.3	261	951	----------	----------	----------	----------	200	800	----------	[c]61
Alabama, Colorado, Ohio, and Utah	[b]3.8	26,195	63,548	10,292	23,653	----------	----------	15,904	39,887	----------	----------
	[b]2.7	91,472	226,875	26,865	52,997	6,147	9,304	33,946	112,657	----------	[c]26,791

1923											
By-product ovens											
Alabama	4.4	284, 530	641, 049	153, 217	313, 846	11, 829	24, 047	36, 101	128, 170	19, 430	28, 022
Colorado	4.4	28, 999	(a)	22, 765	(a)	7, 082	(a)				
Illinois	5.5	250, 778	587, 193	162, 210	384, 369	2, 518	4, 407	44, 329	107, 755	9, 113	
Indiana	6.2	439, 891	1, 208, 659	191, 170	504, 161	49, 236	117, 371	80, 201	255, 983	66, 773	
Maryland	6.6	76, 915	(a)	7, 451	(a)	20, 970	(a)	4, 574	(a)	43, 920	
Massachusetts	6.2	49, 377	(a)	23, 617	(a)	1, 317	(a)	25, 880	(a)	9, 132	
Michigan	4.7	107, 603	278, 675	49, 749	127, 219			31, 341	84, 436	23, 766	2, 436
Minnesota	6.0	60, 320	151, 310	50, 680	100, 067	11, 086	35, 475	16, 523	44, 804		
New Jersey	5.3	63, 803	(a)	55, 676	(a)			14, 206	(a)	1, 270	
New York	6.2	161, 368	558, 577	88, 670	184, 133	40	80	55, 286	324, 281	5, 271	
Ohio	6.7	619, 300	2, 435, 807	340, 128	1, 153, 838	34, 519	73, 824	167, 719	820, 124	70, 147	96
Pennsylvania	7.2	967, 872	2, 276, 082	511, 639	961, 410	239, 370	434, 200	165, 879	744, 691	44, 657	10, 502
Tennessee	4.2	7, 143	12, 643					5, 417	9, 582	1, 726	
Washington	10.0	5, 457	5, 457	5, 452	5, 452			5	18		
West Virginia	6.7	93, 205	85, 193	42, 682	37, 500	4, 858	3, 949	26, 076	26, 319	18, 881	708
Kentucky, Missouri, Rhode Island, and Wisconsin	5.6	116, 153	216, 497	78, 385	145, 256	11, 771	32, 030	16, 801	32, 166	1, 700	7, 624
Undistributed			591, 272		283, 719		61, 270		138, 516		
	6.1	3, 332, 714	9, 048, 414	1, 783, 521	4, 200, 970	394, 596	786, 653	690, 338	2, 716, 845	315, 786	49, 388
Beehive ovens											
Alabama	[b]1.7	1, 368	2, 452	1, 319	2, 374					49	
Colorado	[b]1.0	2, 978	7, 971					2, 978	7, 977		
Pennsylvania	[b]3.3	195, 373	477, 766	61, 351	97, 412	16, 547	45, 695	30, 568	110, 195	1, 041	[c]85, 212
Tennessee	[b]1.8	4, 596	8, 758	2, 672	5, 294			350	950		[c]1, 574
Virginia	[b].9	4, 437	20, 578					3, 550	18, 459		[c]888
West Virginia	[b].5	1, 290	3, 450					415	1, 254		[c]810
New Mexico, Ohio, Oklahoma, and Utah	[b]2.2	19, 299	42, 783					19, 299	42, 783		
	[b]2.8	229, 341	563, 758	65, 342	105, 080	16, 547	45, 695	57, 160	181, 618	1, 090	[c]88, 514

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[a] Included under "Undistributed."

[b] Yield computed by dividing the production of breeze at the few plants reporting by the quantity of coal charged at those plants.

[c] **As reported; quantity produced but not used was undoubtedly greater. See U. S. Geol. Survey Mineral Resources, 1922, pt. 2, pp. 726-727, 1925.**

DISPOSAL, SALES, AND STOCKS

TABLE 35.—*By-product coke produced and sold or used by the producer in the United States, 1922–23*

[Exclusive of screenings and breeze]

State	Produced		Sold								Used by producer (net tons)
			Furnace		Foundry		Domestic and other		Total		
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	
1922											
Alabama	3,493,656	$12,972,839	64,040	$321,449	265,930	$1,511,173	109,906	$576,988	439,876	$2,409,610	3,075,709
Colorado	364,678	(a)	----	----	----	----	18,697	(a)	18,697	(a)	347,007
Illinois	1,982,906	18,164,549	106,571	869,249	156,576	1,327,201	753,724	7,910,849	1,016,871	10,107,299	1,071,098
Indiana	3,995,505	28,978,431	67,183	451,337	155,207	1,593,867	240,833	2,137,797	463,223	4,183,001	3,656,113
Kentucky	456,645	3,397,439	286,254	1,900,027	112,658	1,047,677	76,880	591,681	475,792	3,539,385	----
Maryland	589,893	(a)	----	----	----	----	114,710	(a)	114,710	(a)	482,787
Massachusetts	407,081	(a)	----	----	239,943	(a)	156,532	(a)	396,475	(a)	16,843
Michigan	1,142,059	9,229,083	235,048	1,610,079	120,139	1,194,182	501,714	4,140,824	856,901	6,945,085	354,449
Minnesota	462,044	4,641,871	----	----	58,128	733,353	250,610	2,818,220	308,738	3,551,573	227,732
New Jersey	790,811	(a)	86,192	720,472	196,996	(a)	700,115	(a)	983,303	(a)	123,078
New York	1,494,992	11,865,785	210,538	2,112,480	6,997	61,401	142,230	1,330,550	359,765	3,504,431	1,158,373
Ohio	4,911,670	32,387,137	722,144	4,250,254	11,206	86,964	326,550	1,714,093	1,059,900	6,051,311	3,846,693
Pennsylvania	7,151,912	36,702,974	628,759	4,498,506	7,053	93,485	81,087	463,990	716,899	5,055,981	6,545,022
Tennessee	27,454	202,336	5,436	32,822	10,648	82,764	11,076	84,828	27,160	200,414	----
Washington	5,611	44,439	----	----	----	----	1,952	20,007	1,952	20,007	5,037
West Virginia	501,894	3,074,934	278,130	1,612,775	----	----	89,014	780,488	367,144	2,393,263	149,442
Missouri, Rhode Island, and Wisconsin	771,734	7,520,701	244,629	2,257,044	260,252	2,776,419	290,121	2,757,296	795,002	7,790,759	47,440
Undistributed	----	19,094,249	----	----	----	5,412,945	----	9,079,443	----	15,212,860	----
	28,550,545	188,276,767	2,934,924	20,636,494	1,601,733	15,921,431	3,865,751	34,407,054	8,402,408	70,964,979	21,106,823

State	Produced		Sold					
			Furnace				Foundry	
	Net tons	Value	To affiliated corporations		Merchant sales		Net tons	Value
			Net tons	Value	Net tons	Value		
1923								
Alabama	4,385,366	$18,156,491	103,367	$593,327	68,283	$405,146	279,721	$2,050,208
Colorado	448,243	(a)						
Illinois	3,187,168	30,373,638			67,371	586,550	180,620	1,680,491
Indiana	5,042,614	46,765,264	56	491	660	7,035	199,832	2,387,066
Maryland	861,668	(a)						
Massachusetts	554,125	(a)					306,328	(a)
Michigan	1,648,773	14,389,742			264,293	2,103,772	186,918	2,072,921
Minnesota	695,824	5,104,330					45,768	623,898
New Jersey	897,569	(a)			17,415	(a)	185,252	(a)
New York	1,783,948	12,808,335	645,087	4,865,181	233,153	1,452,462		
Ohio	6,323,810	40,712,282	539,423	3,589,141	350,347	1,737,330	5,526	44,132
Pennsylvania	9,185,747	43,520,249	1,025,479	7,258,914	198,674	1,581,350	800	4,844
Tennessee	124,160	825,542			23,126	146,647	68,563	475,018
Washington	31,081	237,148						
West Virginia	940,866	5,345,432			86,349	526,917		
Kentucky, Missouri, Rhode Island, and Wisconsin	1,486,702	15,755,203			150,867	1,148,261	438,627	5,195,670
Undistributed		23,597,662				151,585		5,461,094
	37,597,664	257,591,318	2,313,412	16,307,054	1,460,538	9,847,055	1,897,955	19,995,342

[a] Included under "Undistributed."

TABLE 35.—*By-product coke produced and sold or used by the producer in the United States, 1922–23*—Continued

State	Sold—Continued						Used by producer in blast furnace, etc.	
	Domestic use		Industrial and other use		Total			
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
1923								
Alabama	97, 342	$663, 854	95, 206	$423, 157	643, 919	$4, 135, 692	3, 991, 309	$14, 904, 844
Colorado			34, 772	(a)	34, 772	(a)	413, 583	(a)
Illinois	351, 422	3, 097, 896	323, 481	3, 704, 302	922, 894	9, 069, 239	1, 907, 479	17, 840, 000
Indiana	164, 613	1, 025, 687	104, 681	1, 003, 810	469, 842	4, 424, 089	4, 511, 227	41, 793, 311
Maryland			126, 139	(a)	126, 139	(a)	738, 538	(a)
Massachusetts	218, 912	(a)			525, 240	(a)	5, 789	(a)
Michigan	481, 150	4, 383, 671	81, 398	768, 262	1, 013, 759	9, 328, 626	534, 775	4, 167, 385
Minnesota	193, 326	2, 505, 009	898	10, 843	239, 992	3, 139, 750	440, 357	4, 498, 330
New Jersey	206, 936	(a)	398, 886	(a)	808, 489	(a)	56, 492	(a)
New York	102, 400	787, 771	60, 920	486, 316	1, 041, 560	7, 591, 730	733, 839	5, 177, 504
Ohio	45, 267	286, 104	48, 450	356, 948	989, 013	6, 013, 655	5, 268, 274	34, 210, 892
Pennsylvania	154, 642	982, 708	37, 147	312, 499	1, 416, 742	10, 140, 315	7, 723, 344	33, 132, 175
Tennessee	21, 343	150, 372			113, 032	772, 037		
Washington	2, 443	20, 766			2, 443	20, 766	29, 687	207, 809
West Virginia	139, 448	902, 228			225, 797	1, 429, 145	678, 357	3, 673, 372
Kentucky, Missouri, Rhode Island, and Wisconsin	458, 274	4, 727, 627	326, 248	3, 293, 345	1, 374, 016	14, 364, 903	22, 347	212, 322
Undistributed		4, 338, 314		4, 486, 170		14, 437, 163		8, 561, 656
	2, 637, 518	23, 872, 007	1, 638, 226	14, 845, 652	9, 947, 649	84, 867, 110	27, 055, 397	168, 379, 600

[a] Included under "Undistributed."

TABLE 36.—*Beehive coke produced and sold or used by the producer in the United States, 1922–23*

[Exclusive of screenings and breeze]

State	Produced		Sold								Used by producer (net tons)
			Furnace		Foundry		Domestic and other		Total		
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	
1922											
Alabama	306,209	$1,735,406	56,837	$276,975	64,276	$351,241	1,762	$8,353	122,875	$636,569	160,774
Colorado	119,361	821,309	14,523	109,547	14,873	123,832	11,815	92,751	41,211	326,130	77,983
Georgia	8,832	74,807	--------	--------	8,767	74,264	--------	--------	8,767	74,264	--------
Kentucky	30,522	216,701	6,230	46,657	--------	--------	--------	--------	6,230	46,657	24,292
New Mexico	87,631	788,679	--------	--------	--------	--------	1,504	13,532	1,504	13,532	86,127
Ohio	99,468	713,186	--------	--------	--------	--------	--------	--------	--------	--------	104,968
Pennsylvania	6,839,980	38,091,586	5,355,374	28,697,120	837,654	5,991,486	126,880	710,412	6,319,908	35,399,018	486,771
Tennessee	86,442	618,542	12,393	82,751	2,070	13,566	--------	--------	14,463	96,317	71,979
Utah	172,453	1,406,109	167,377	1,369,972	1,732	13,375	3,344	22,762	172,453	1,406,109	--------
Virginia	378,656	2,291,336	227,629	1,318,616	123,568	779,102	7,987	63,718	359,184	2,161,436	19,201
Washington	26,063	241,442	13,791	129,208	--------	--------	--------	--------	13,791	129,208	11,860
West Virginia	417,850	3,037,453	250,849	1,693,594	111,776	987,534	26,378	174,486	389,003	2,855,614	27,931
	8,573,467	50,036,556	6,105,003	33,724,440	1,164,716	8,334,400	179,670	1,086,014	7,449,389	43,144,854	1,071,886

TABLE 36.—*Beehive coke produced and sold or used by the producer in the United States, 1922–23*—Continued

State	Produced		Sold					
			Furnace				Foundry	
			To affiliated corporations		Merchant sales			
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
1923								
Alabama	268, 709	$1, 660, 903			3, 536	$22, 189	129, 384	$794, 056
Colorado	199, 580	(a)	90, 122	(a)	49, 644	(a)	5, 261	(a)
Georgia	12, 556	126, 690					12, 112	122, 229
Kentucky	125, 595	874, 752	112, 863	(a)	12, 704	(a)		
Ohio	149, 796	(a)						
Pennsylvania	16, 438, 539	94, 923, 942	7, 562, 300	$43, 015, 059	5, 457, 530	32, 326, 516	1, 114, 315	7, 719, 015
Tennessee	180, 351	1, 244, 011			19, 723	149, 343	8, 762	64, 850
Utah	232, 941	1, 977, 669			226, 488	1, 921, 806	2, 137	18, 673
Virginia	774, 887	5, 036, 612			252, 041	1, 608, 277	186, 938	1, 371, 858
Washington	37, 987	347, 364	23, 559	212, 031			14, 428	135, 333
West Virginia	821, 909	5, 758, 284	54, 060	316, 880	364, 605	2, 303, 563	225, 534	1, 966, 031
New Mexico and Oklahoma	137, 020	1, 157, 400	80, 879	688, 280	51, 500	498, 872	3, 893	23, 360
Undistributed		2, 747, 953		1, 524, 743		496, 127		43, 791
	19, 379, 870	115, 905, 580	7, 923, 783	45, 756, 993	6, 437, 771	39, 326, 693	1, 702, 764	12, 259, 196

State	Sold—Continued						Used by producer in blast furnace, etc.	
	Domestic use		Industrial and other use		Total			
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
1923								
Alabama			42, 985	$294, 637	175, 905	$1, 110, 882	111, 414	$661, 328
Colorado			41, 321	(a)	186, 348	(a)	12, 576	(a)
Georgia					12, 112	122, 229		
Kentucky					125, 567	(a)		
Ohio							151, 765	(a)
Pennsylvania	94, 423	$452, 928	279, 623	1, 605, 761	14, 508, 191	85, 119, 279	1, 932, 717	9, 764, 959
Tennessee			14, 378	61, 758	42, 863	275, 951	136, 432	961, 239
Utah			4, 470	37, 881	233, 095	1, 978, 360		
Virginia			170, 641	1, 082, 323	609, 620	4, 062, 458	159, 696	990, 477
Washington					37, 987	347, 364		
West Virginia	784	3, 163	91, 393	649, 148	736, 376	5, 238, 785	78, 907	473, 442
New Mexico and Oklahoma	689	5, 880	851	7, 196	137, 812	1, 223, 588		
Undistributed				373, 532		2, 438, 193		1, 194, 201
	95, 896	461, 971	645, 662	4, 112, 236	16, 805, 876	101, 917, 089	2, 583, 507	14, 045, 646

[a] Included under "Undistributed."

TABLE 37.—*Stocks of unsold coke at 21 by-product coke plants supplying gas for city use, 1922–23, in net tons*

Jan. 1, 1922	1,017,000	June 1, 1923	202,000
Mar. 1, 1922	987,000	July 1, 1923	308,000
Oct. 1, 1922	250,000	Aug. 1, 1923	429,000
Nov. 1, 1922	228,000	Sept. 1, 1923	501,000
Jan. 1, 1923	212,000	Oct. 1, 1923	476,000
Feb. 1, 1923	146,000	Dec. 31, 1923	772,000
Mar. 1, 1923	92,000		

TABLE 38.—*Stocks of furnace and foundry coke and of breeze at the end of 1922 and 1923, by States, in net tons*

State	Furnace	Foundry	Breeze
1922			
By-product plants			
Alabama	487,039	394	64,962
Colorado	1,823	-----	848
Illinois	8,617	474	12,449
Indiana	14,223	249	12,075
Kentucky	1,037	405	329
Maryland	6,033	-----	-----
Massachusetts	-----	6,983	10,569
Michigan	1,441	6,925	5,101
Minnesota	98,371	-----	7,505
New Jersey	2,950	-----	150
New York	20,658	-----	13,983
Ohio	30,472	295	14,984
Pennsylvania	21,940	-----	7,771
Tennessee	102	192	614
Washington	4,153	-----	-----
West Virginia	1,871	-----	273
Missouri, Rhode Island, and Wisconsin	5,863	6,625	5,729
	706,598	22,542	157,342
Beehive plants			
Alabama	38,359	983	-----
Colorado	182	-----	-----
Georgia	-----	65	-----
New Mexico	821	-----	-----
Ohio	5,500	-----	-----
Pennsylvania	38,195	2,169	8,862
Tennessee	2,167	103	25
Virginia	1,808	178	-----
Washington	412	-----	-----
West Virginia	1,499	100	-----
	88,943	3,598	8,887
1923			
By-product plants			
Alabama	268,340	-----	79,220
Colorado	1,611	100	-----
Illinois	94,565	132,281	29,833
Indiana	13,830	36,490	81,696
Maryland	3,024	-----	43,920
Massachusetts	-----	20,364	9,715
Michigan	1,182	31,090	24,369
Minnesota	121,464	-----	-----
New Jersey	15,695	19,843	1,230
New York	24,040	1,271	27,716
Ohio	80,027	21,947	77,129
Pennsylvania	74,425	72	59,830
Tennessee	11,302	120	1,726
Washington	-----	4,537	-----
West Virginia	29,502	8,868	1,194
Kentucky, Missouri, Rhode Island, and Wisconsin	9,368	107,413	27,177
	748,375	384,396	464,755
Beehive plants			
Alabama	20,018	1,263	49
Colorado	1,537	-----	-----
Georgia	-----	520	-----
Kentucky	1,457	-----	-----
Ohio	2,969	-----	-----
Pennsylvania	37,916	3,692	17,758
Tennessee	850	989	50
Utah	225	-----	-----
Virginia	9,018	575	-----
Washington	-----	-----	-----
West Virginia	5,735	380	-----
New Mexico and Oklahoma	1,621	201	-----
	81,346	7,620	17,857

TABLE 39.—*Coke consumed in the manufacture of pig iron, 1913–1923*

[From annual report of the American Iron and Steel Institute

Year	Coke consumed		Pig iron produced [a] (gross tons)
	Net tons	Pounds (coke and bituminous coal) per gross ton of pig iron produced	
1913	37, 192, 287	2, 433. 3	30, 326, 130
1914	27, 070, 856	2, 354. 4	22, 976, 856
1915	33, 224, 328	2, 252. 0	29, 535, 308
1916	44, 431, 905	2, 285. 3	38, 844, 598
1917	44, 493, 316	2, 339. 7	37, 863, 643
1918	45, 703, 594	2, 375. 2	38, 422, 175
1919	35, 250, 943	2, 310. 2	30, 549, 930
1920	41, 976, 171	2, 305. 6	36, 300, 024
1921	18, 162, 147	2, 200. 6	16, 579, 653
1922	29, 213, 893	2, 176. 3	26, 995, 173
1923	44, 761, 526	2, 243. 3	40, 097, 239

[a] Excludes pig iron made with anthracite and charcoal but includes small quantities made with electricity and bituminous coal.

VALUE AND PRICE

TABLE 40.—*Value of coke produced in the United States, 1922–23*

[Exclusive of screenings and breeze]

State	1922	1923	Increase, 1923			
			Total	Percentage		
				Total	By-product	Beehive
Alabama	$14, 708, 245	$19, 817, 394	$5, 109, 149	34. 7	40. 0	[b] 4. 3
Colorado	([a])	([a])	([a])	([a])	([a])	([a])
Georgia	74, 807	126, 690	51, 883	69. 4	--------	69. 4
Illinois	18, 164, 549	30, 373, 638	12, 209, 089	67. 2	67. 2	--------
Indiana	28, 978, 431	46, 765, 264	17, 786, 833	61. 4	61. 4	--------
Kentucky	3, 614, 140	([a])	([a])	([a])	([a])	303. 7
Maryland	([a])	([a])	([a])	([a])	([a])	--------
Massachusetts	([a])	([a])	([a])	([a])	([a])	--------
Michigan	9, 229, 083	14, 389, 742	5, 160, 659	55. 9	55. 9	--------
Minnesota	4, 641, 871	5, 104, 330	462, 459	10. 0	10. 0	--------
Missouri	([a])	([a])	([a])	([a])	([a])	--------
New Jersey	([a])	([a])	([a])	([a])	([a])	--------
New Mexico	788, 679	([a])	([a])	([a])	--------	([a])
New York	11, 865, 785	12, 808, 335	942, 550	7. 9	7. 9	--------
Ohio	33, 100, 323	([a])	([a])	([a])	25. 7	([a])
Oklahoma	--------	([a])	([a])	([a])	--------	([a])
Pennsylvania	74, 794, 560	138, 444, 191	63, 649, 631	85. 1	18. 6	149. 2
Rhode Island	([a])	([a])	([a])	([a])	([a])	--------
Tennessee	820, 878	2, 069, 553	1, 248, 675	152. 1	308. 0	101. 1
Utah	1, 406, 109	1, 977, 669	571, 560	40. 6	--------	40. 6
Virginia	2, 291, 336	5, 086, 612	2, 795, 276	122. 0	--------	122. 0
Washington	285, 881	584, 512	298, 631	104. 5	433. 6	43. 9
West Virginia	6, 112, 387	11, 103, 716	4, 991, 329	81. 7	73. 8	89. 3
Wisconsin	([a])	([a])	([a])	([a])	([a])	--------
Combined States	27, 436, 259	84, 845, 252	19, 905, 851	30. 7	31. 1	68. 1
	238, 313, 323	373, 496, 898	135, 183, 575	56. 7	36. 8	131. 6

[a] Included under "Combined States."
[b] Decrease.

TABLE 41.—*Average receipts per ton for coke sold in the United States in 1922*

State	By-product			Beehive		
	Furnace	Foundry	Domestic	Furnace	Foundry	Domestic
Alabama	$5.02	$5.68	$5.25	$4.87	$4.87	$4.74
Colorado			(a)	7.54	8.32	7.85
Georgia					8.46	
Illinois	8.15	8.47	10.50			
Indiana	6.72	10.27	8.88			
Kentucky	6.64	9.30	7.69	7.49		
Maryland			(a)			
Massachusetts		(a)	(a)			
Michigan	6.85	9.94	8.25			
Minnesota		12.62	11.24			
Missouri	(a)	(a)	(a)			
New Jersey	8.36	(a)	(a)			
New Mexico						9.00
New York	10.03	8.77	9.35			
Ohio	5.88	7.76	5.25			
Pennsylvania	7.15	[b]13.25	5.72	5.36	7.15	5.60
Rhode Island		(a)				
Tennessee	6.04	7.77	7.65	6.68	6.55	
Utah				8.18	7.72	6.81
Virginia				5.79	6.33	7.98
Washington			10.25	9.37		
West Virginia	5.80		8.77	6.75	8.84	6.61
Wisconsin	(a)	(a)	(a)			
Combined States	9.23	10.31	9.25			
	7.03	9.94	8.90	5.52	7.15	6.04

(a) Included under "Combined States."

[b] Only 7,053 tons of by-product foundry coke was sold in this State.

TABLE 42.—*Average receipts per ton for coke sold in the United States in 1923*

State	By-product					Beehive				
	Furnace		Foundry	Domestic	Industrial, etc.	Furnace		Foundry	Domestic	Industrial, etc.
	To affiliated corporations	Merchant sales				To affiliated corporations	Merchant sales			
Alabama	$5.74	$5.93	$7.33	$6.82	$4.44		$6.28	$6.14		$6.85
Colorado					(a)	$8.15	8.29	8.32		(a)
Georgia								10.09		
Illinois		8.70	9.30	8.82	11.45					
Indiana	8.77	10.66	11.94	6.23	9.59					
Kentucky		(a)	(a)	(a)		7.00	6.65			
Maryland					(a)					
Massachusetts			(a)	(a)						
Michigan		7.96	11.09	9.11	9.44					
Minnesota			13.63	12.96	12.07					
Missouri			(a)	(a)	(a)					
New Jersey		(a)	(a)	(a)	(a)					
New Mexico						(a)	(a)		(a)	(a)
New York	7.54	6.23		7.69	7.98					
Ohio	6.65	4.96	7.99	7.98	7.37					
Oklahoma								(a)	(a)	(a)
Pennsylvania	7.08	7.96	6.05	6.35	8.41	5.69	5.92	6.93	$4.80	5.74
Rhode Island			(a)	(a)						
Tennessee		6.34	6.93	7.04			7.57	7.40		4.30
Utah							8.49	8.74		8.48
Virginia							6.38	7.34		6.34
Washington				(a)		9.00		9.38		
West Virginia		6.10		6.47		5.86	6.32	8.72	4.03	7.10
Wisconsin			(a)	(a)	(a)					
Combined States		7.72	11.46	10.25	8.78	8.51	9.69	6.00	8.53	9.03
	7.05	6.74	10.54	9.05	9.06	5.77	6.11	7.20	4.82	6.37

(a) Included under "Combined States."

TABLE 43.—*Average value per ton of all coke produced, 1913–1923, and average receipts per ton from coke sold, 1918–1923*

Year	Value per ton produced [a]			Receipts per ton sold		
	By-product	Beehive	Total	By-product	Beehive	Total
1913	$3.83	$2.39	$2.78	(b)	(b)	(b)
1914	3.39	2.15	2.56	(b)	(b)	(b)
1915	3.45	2.07	2.54	(b)	(b)	(b)
1916	3.95	2.69	3.13	(b)	(b)	(b)
1917	6.18	4.81	5.36	(b)	(b)	(b)
1918	7.42	6.21	6.77	$7.88	$6.08	$6.52
1919	6.37	5.15	5.85	6.58	5.05	5.60
1920	10.15	7.94	9.27	10.77	7.43	8.50
1921	5.95	5.45	5.84	7.72	5.41	6.56
1922	6.59	5.84	6.42	8.45	5.79	7.19
1923	6.85	5.98	6.56	8.53	6.06	6.98

[a] Includes operators' statement of the value of coke consumed by them in associated enterprises but not sold, except that in 1918 and 1920 the value of such coke was estimated by the Geological Survey for each State at the average value for that State of the part of the product reported sold.

[b] Data not available.

TABLE 44.—*Average monthly prices per net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1903–1923* [a]

Month	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Furnace																					
January	$5.00	$1.60	$2.46	$2.62	$3.53	$1.92	$1.59	$2.55	$1.40	$1.82	$3.88	$1.85	$1.50	$2.94	$9.50	$6.00	$5.65	$6.00	$5.06	$2.75	$8.05
February	5.00	1.52	2.56	2.14	3.50	1.86	1.59	2.12	1.45	1.78	2.52	1.85	1.50	3.38	9.62	6.00	4.44	6.00	4.50	3.01	7.13
March	5.00	1.65	2.43	2.24	3.02	1.72	1.60	2.00	1.55	2.12	2.40	1.90	1.50	3.47	9.60	6.00	4.06	6.00	4.35	3.25	7.25
April	4.29	1.60	2.07	2.45	2.72	1.57	1.60	1.77	1.59	2.39	2.15	1.86	1.50	2.41	7.38	6.00	3.65	9.60	3.50	4.48	6.31
May	3.50	1.50	1.87	2.46	2.16	1.50	1.57	1.66	1.50	2.28	2.13	1.77	1.50	2.30	7.80	6.00	3.69	12.00	3.25	6.00	5.15
June	3.00	1.45	1.82	2.32	1.89	1.55	1.52	1.65	1.42	2.02	2.11	1.75	1.56	2.49	11.25	6.00	4.00	15.00	3.00	6.75	4.75
July	2.50	1.45	1.81	2.51	2.40	1.57	1.58	1.59	1.44	2.21	2.45	1.75	1.64	2.75	12.75	6.00	4.07	17.20	2.81	10.75	4.55
August	2.25	1.45	1.80	2.76	2.62	1.50	1.66	1.57	1.46	2.21	2.50	1.70	1.50	2.80	13.60	6.00	4.31	17.75	2.75	12.80	4.56
September	2.20	1.45	2.10	2.85	2.82	1.50	2.39	1.60	1.50	2.37	2.29	1.65	1.61	2.94	11.12	6.00	4.56	16.70	3.15	11.13	4.50
October	1.90	1.47	2.61	2.84	2.85	1.53	2.76	1.59	1.50	3.41	2.98	1.60	2.03	4.88	6.00	6.00	4.52	15.12	3.28	9.60	3.85
November	1.75	2.04	2.95	3.13	2.41	1.72	2.74	1.50	1.52	3.94	1.82	1.52	2.28	6.90	6.00	6.00	5.87	8.26	3.03	7.19	3.81
December	1.62	2.12	2.79	3.52	2.06	1.82	2.67	1.44	1.60	4.00	1.75	1.50	2.64	8.38	6.00	6.00	6.12	6.20	2.75	7.00	4.00
Average	3.16	1.61	2.27	2.65	2.67	1.65	1.94	1.75	1.49	2.55	2.42	1.73	1.73	3.80	9.22	6.00	4.58	11.32	3.45	7.06	5.33
Foundry																					
January	6.50	2.18	2.38	3.42	4.25	2.45	2.00	2.90	1.90	1.97	4.40	2.50	2.00	3.50	9.75	7.00	6.25	7.00	6.38	3.75	8.70
February	6.50	2.10	2.68	2.65	4.00	2.39	1.95	2.70	2.10	2.09	3.25	2.50	2.00	3.50	11.00	7.00	5.00	7.00	5.63	4.00	8.25
March	6.50	2.25	2.75	2.78	3.65	2.25	1.95	2.60	2.05	2.56	3.00	2.45	2.00	3.75	11.60	7.00	4.94	7.00	5.45	4.25	8.38
April	5.50	2.15	2.70	2.95	3.31	2.22	1.86	2.45	2.00	2.69	3.00	2.40	2.00	3.56	9.13	7.00	4.30	10.20	4.75	5.06	7.56
May	4.50	2.00	2.55	2.81	3.00	2.03	1.85	2.20	1.81	2.58	2.85	2.40	2.00	3.25	8.90	7.00	4.31	13.00	4.50	6.30	6.15
June	3.50	1.90	2.40	2.65	3.00	2.00	1.80	2.17	1.76	2.40	2.80	2.32	2.00	3.25	11.72	7.00	4.56	15.75	4.45	7.25	5.56
July	3.25	1.80	2.35	2.79	3.00	2.00	2.00	2.15	1.82	2.40	2.70	2.22	2.05	3.25	13.25	7.00	5.00	17.80	4.06	11.00	5.35
August	3.00	1.75	2.25	3.00	3.08	1.92	1.95	2.15	1.85	2.40	2.90	2.25	2.00	3.30	13.20	7.00	5.25	18.88	3.75	13.90	5.38
September	2.87	1.85	2.50	3.19	3.20	1.90	2.55	2.12	1.85	2.54	2.90	2.10	2.07	3.31	11.75	7.00	5.80	17.70	4.15	12.50	5.50
October	2.87	2.00	3.00	3.31	3.25	2.10	2.90	2.10	1.81	3.65	2.81	2.00	2.35	3.88	6.00	7.00	6.25	16.38	4.[illegible]8	11.7	4.80
November	2.50	2.25	3.50	4.00	2.75	2.20	3.25	2.05	1.85	4.25	2.60	1.92	2.88	7.10	7.00	7.00	7.00	9.50	4.19	8.38	4.81
December	2.25	2.35	3.50	4.12	2.50	2.25	3.20	1.97	1.90	4.50	2.50	1.90	2.95	8.63	7.00	7.00	7.00	7.00	3.81	7.88	4.81
Average	4.15	2.05	2.71	3.14	3.25	2.14	2.27	2.30	1.89	2.84	2.98	2.25	2.19	4.19	10.03	7.00	5.47	12.27	4.63	8.00	6.27

[a] Iron Age, January 3, 1924 p. 85

EXPORTS AND IMPORTS

TABLE 45.—*Coke exported from the United States, 1909–1923* [a]

Year	Net tons	Value	Year	Net tons	Value
1909	1,002,916	$3,232,673	1917	1,409,320	$8,543,746
1910	984,618	3,053,293	1918	1,687,824	11,861,408
1911	1,023,727	3,215,990	1919	716,956	5,128,119
1912	912.576	3,002,742	1920	919,802	9,993,665
1913	987,395	3,309,930	1921	306,755	2,760,939
1914	663,585	2,233,686	1922	511,541	4,319,538
1915	895,509	3,092,498	1923	1,237,342	11,889,897
1916	1,174,645	4,202,236			

[a] Compiled from records of the Bureau of Foreign and Domestic Commerce.

TABLE 46.—*Coke exported from the United States, 1921–1923, by customs districts* [a]

District	1921		1922		1923	
	Net tons	Value	Net tons	Value	Net tons	Value
Arizona	186	$2,571	25,873	$211,436	66,363	$552,698
Buffalo	105,378	940,539	206,995	1,519,685	400,597	3,536,828
Dakota	8,072	70,560	28,344	282,050	25,339	283,804
Duluth-Superior	1,455	14,945	3,359	33,288	2,894	33,570
El Paso	6,067	43,781	4,135	40,415	10,637	128,442
Florida	5,226	89,260	3,328	40,190	7,730	112,985
Galveston	46	581	48	995		
Georgia	225	3,492	782	9,500		
Los Angeles					73	1,571
Maine and New Hampshire	345	2,282	2,762	25,342	4,633	51,801
Maryland	20,315	127,050	15,943	95,310	190,502	1,893,238
Massachusetts					28	236
Michigan	86,905	757,439	145,013	1,310,144	193,972	1,918,854
Mobile	151	2,397	10,408	70,967	8,865	113,816
New Orleans	1,755	33,762	11,185	155,152	13,569	171,709
New York	7,710	124,288	7,184	100,332	14,567	222,348
Ohio	6,140	37,280	3,760	35,971	65,619	387,820
Philadelphia	13,321	128,354	16,215	145,658	152,930	1,769,580
Porto Rico	4	94	24	438	20	324
Rochester	998	9,988	274	2,534	1,770	11,450
Sabine	246	1,845	27	333	6,713	48,332
St. Lawrence	16,570	120,100	10,078	108,061	37,746	381,929
San Antonio	19,204	159,585	3,308	14,661	3,782	26,787
San Diego	3	63	1	30		
San Francisco	391	9,456	157	3,973	111	2,569
South Carolina			714	2,898		
Vermont	1,734	13,596	9,042	89,674	15,698	162,632
Virginia	4,181	66,463	2,272	17,255	13,162	76,164
Washington	127	1,168	310	3,246	22	410
	306,755	2,760,939	511,541	4,319,538	1,237,342	11,889,897

[a] Compiled from records of the Bureau of Foreign and Domestic Commerce.

TABLE 47.—*Coke exported from the United States, 1921–1923, by countries of destination* [a]

Destination	1921		1922		1923	
	Net tons	Value	Net tons	Value	Net tons	Value
Argentina	2,219	$43,123			110	$1,250
Barbados	17	185				
Belgium	2,256	24,648	224	$2,285	101,529	1,083,370
Bermuda	3	70	3	47	1	20
Brazil	833	11,731	4	62	6	92
British Honduras	8	138	7	122	4	71
British West Africa	22	426				
Canada	227,641	1,967,108	410,828	3,416,769	748,219	6,768,462
Chile	5,572	34,601	11,975	75,126	41,548	297,444
Colombia	157	3,402	105	2,578	57	1,250
Costa Rica	67	1,278	67	1,446	110	1,961
Cuba	7,026	110,736	5,387	52,642	7,073	86,378
Denmark					24	451
Dominican Republic	99	1,995	73	1,326	127	2,621
Ecuador	71	1,309	34	803	90	2,186
England	99	920	631	6,500	2,955	44,370
France	2,880	40,100	8,641	112,698	143,828	1,604,131
French Oceania	2	49	7	132	2	44
French West Indies	7	136				
Germany	3,333	30,874	5,459	58,682	60,141	749,058
Guatemala	84	1,538	34	541	96	1,875
Haiti	2	40			11	200
Honduras	38	620	36	647	122	2,139
Ireland					22	208
Italy	560	4,000	4,754	46,921	27,866	260,694
Jamaica	36	614	1,195	8,336	7	185
Mexico	31,232	262,167	34,390	283,565	81,688	724,396
Netherlands	4,496	72,643	9,500	124,841	8,103	108,217
Newfoundland and Labrador					36	498
Nicaragua	6	123	58	1,123	22	539
Norway	1,165	12,785	1,313	12,772	9,785	102,771
Other British West Indies			11	240	102	1,335
Panama	250	8,368	186	3,933	179	4,588
Paraguay			34	713		
Peru	15,028	101,974	11,382	56,694	122	1,333
Philippine Islands	450	8,309				
Portugal	299	2,139				
Salvador	36	997	60	1,440	50	1,155
Scotland	280	3,728	4,552	39,560	1,075	15,800
Spain	11	175			1,122	10,220
Sweden	11	400				
Switzerland			515	5 286		
Trinidad and Tobago	11	200	4	100	11	130
Turkey in Europe	224	4,000				
Uruguay	121	1,296				
Venezuela	101	1,945	56	1,308	1,098	10,440
Virgin Islands of the United States	2	49	16	300	1	15
	306,755	2,760,939	511,541	4,319,538	1,237,342	11,889,897

[a] Compiled from records of the Bureau of Foreign and Domestic Commerce.

TABLE 48.—*Coke exported from the United States, 1921–1923, by months* [a]

Month	1921		1922		1923	
	Net tons	Value	Net tons	Value	Net tons	Value
January	41,154	$465,321	34,420	$266,809	87,090	$923,691
February	30,507	340,555	35,318	273,620	79,508	855,678
March	28,068	287,881	28,487	236,703	109,224	1,124,789
April	21,127	177,960	31,822	243,417	226,002	2,405,744
May	17,518	151,840	24,414	201,124	185,520	1,816,332
June	22,300	210,796	32,581	258,902	71,503	680,325
July	21,425	173,687	31,008	251,669	67,717	600,728
August	20,192	157,765	29,255	293,043	111,145	896,665
September	19,750	149,352	39,729	448,061	106,936	930,039
October	24,927	193,598	43,247	503,716	87,065	744,987
November	33,989	254,484	43,005	492,495	55,287	490,443
December	25,798	197,700	138,255	849,979	50,345	420,476
	306,755	2,760,939	511,541	4,319,538	1,237,342	11,889,897

[a] Compiled from records of the Bureau of Foreign and Domestic Commerce.

TABLE 49.—*Coke imported for consumption in the United States, 1908–1923* [a]

Year	Net tons	Value	Year	Net tons	Value
1908	147, 427	$606, 294	1916	54, 955	$249, 514
1909	191, 253	736, 120	1917	24, 872	146, 451
1910	172, 716	625, 130	1918	30, 168	221, 880
1911	77, 923	254, 455	1919	16, 486	140, 653
1912	123, 614	488, 398	1920	41, 143	403, 175
1913	101, 212	435, 157	1921	30, 990	336, 394
1914	133, 226	551, 104	1922	94, 228	802, 987
1915	53, 222	222, 382	1923	85, 002	862, 596

[a] Compiled from records of the Bureau of Foreign and Domestic Commerce

TABLE 50.—*Coke imported into the United States, 1921–1923, by customs districts* [a]

District	1921		1922		1923	
	Net tons	Value	Net tons	Value	Net tons	Value
Alaska			799	$5, 704		
Buffal	1, 077	$14, 156	654	4, 902	8, 416	$140, 935
Chicago					1	50
Hawaii	449	9, 582	231	1, 633	339	3, 137
Los Angeles	222	1, 690	14, 659	96, 565	12, 588	114, 049
Maine and New Hampshire	350	3, 041	1, 365	12, 688	342	3, 349
Massachusetts			10, 730	125, 849		
Michigan			58	421	1, 018	22, 015
Montana and Idaho	20, 476	237, 410	16, 593	185, 338	25, 697	275, 107
New York			8, 869	75, 894	11, 336	75, 018
Oregon	588	6, 037	1, 338	9, 001	1, 564	14, 253
Philadelphia			3, 068	37, 637		
San Francisco	7, 671	63, 255	31, 723	222, 505	21, 573	198, 262
Vermont	80	530	87	702	84	771
Washington	77	693	4, 054	24, 148	2, 044	15, 650
	30, 990	336, 394	94, 228	802, 987	85, 002	862, 596

[a] Compiled from records of the Bureau of Foreign and Domestic Commerce.

TABLE 51.—*Coke imported into the United States, 1921–1923, by countries* [a]

Country	1921		1922		1923	
	Net tons	Value	Net tons	Value	Net tons	Value
Australia	3, 095	$25, 685	903	$6, 078		
Belgium			84	1, 350		
Canada	22, 060	255, 830	18, 572	200, 483	36, 366	$448, 029
China					(b)	10
England	5, 835	54, 879	73, 987	590, 894	47, 410	403, 445
France					1	50
Germany			342	2, 067		
Ireland					663	5, 871
Scotland			340	2, 115	562	5, 191
	30, 990	336, 394	94, 228	802, 987	85, 002	862, 596

[a] Compiled from records of the Bureau of Foreign and Domestic Commerce.
[b] Less than 1 ton.

SHIPMENTS BY RAIL AND WATER

TABLE 52.—*Beehive coke loaded for shipment on originating railroads and waterways in the United States, 1922–23, by States, in net tons, as reported by the coke producers*

State	Railroad	Shipments	Production	Percentage of production shipped
1922				
Alabama	Louisville & Nashville	121, 685		
	St. Louis-San Francisco	80		
	Southern	65, 549		
		187, 314	306, 209	61. 2
Colorado	Colorado & Wyoming	47, 460		
	Denver & Rio Grande Western	71, 734		
		119, 194	119, 361	99. 8
Georgia	Central of Georgia	8, 767	8, 832	99. 3
Kentucky	Chesapeake & Ohio	6, 230		
	Louisville & Nashville	24, 292		
		30, 522	30, 522	100. 0
New Mexico	El Paso & Southwestern	87, 631	87, 631	100. 0
Ohio	Baltimore & Ohio; Pittsburgh & Lake Erie	104, 968	99, 468	105. 5
Pennsylvania	Baltimore & Ohio	721, 657		
	Buffalo, Rochester & Pittsburgh	62, 171		
	Ligonier Valley	60, 306		
	Monongahela	1, 047, 200		
	Pennsylvania	4, 185, 962		
	Pittsburgh & Lake Erie	88, 375		
	Buffalo & Susquehanna; Reynoldsville & Falls Creek; Washington Run.	256, 849		
		6, 422, 520	6, 839, 980	93. 9
Tennessee	Nashville, Chattanooga & St. Louis	13, 703		
	Louisville & Nashville; Southern	760		
		14, 463	86, 442	16. 7
Utah	Denver & Rio Grande Western	172, 453	172, 453	100. 0
Virginia	Chesapeake & Ohio	4, 275		
	Interstate	270, 957		
	Louisville & Nashville	3, 804		
	Norfolk & Western	31, 104		
	Southern	38, 984		
	Louisville & Nashville; Norfolk & Western; Southern.	27, 768		
		376, 892	378, 656	99. 5
Washington	Northern Pacific	25, 651	26, 063	98. 4
West Virginia	Baltimore & Ohio	166, 710		
	Chesapeake & Ohio	96, 181		
	Norfolk & Western	81, 929		
	Western Maryland	14, 994		
	Kanawha & Michigan	57, 315		
		417, 129	417, 850	99. 8
	Total railroad shipments	7, 967, 504		
	Total waterway shipments (Monongahela River, Pa.).	165, 791	([b])	2. 4
	Grand total	8, 133, 295	8, 573, 467	94. 9

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[a] Excess of shipments over production represents inclusion of screenings or withdrawal from stock.
[b] Production shown above.

TABLE 52.—*Beehive coke loaded for shipment on originating railroads and waterways in the United States, 1922–23, by States, in net tons, as reported by the coke producers*—Continued

State	Railroad	Shipments	Production	Percentage of production shipped [a]
1923				
Alabama	Louisville & Nashville	199, 955		
	St. Louis-San Francisco	115		
	Southern	32, 748		
		232, 818	268, 709	86. 6
Colorado	Colorado & Southern	34, 816		
	Colorado & Wyoming	93, 953		
	Denver & Rio Grande Western	71, 153		
		199, 922	199, 580	100. 2
Georgia	Central of Georgia	12, 112	12, 556	96. 5
Kentucky	Chesapeake & Ohio	12, 704		
	Louisville & Nashville	111, 406		
		124, 110	125, 595	98. 8
New Mexico and Oklahoma.	Chicago, Rock Island & Pacific; El Paso & Southwestern.	138, 212	137, 020	100. 8
Ohio			149, 796	
Pennsylvania	Baltimore & Ohio	1, 800, 525		
	Buffalo, Rochester & Pittsburgh	131, 678		
	Ligonier Valley	207, 583		
	Monongahela	3, 834, 004		
	Pennsylvania	8, 167, 495		
	Pittsburgh & Lake Erie	224, 817		
	Buffalo & Susquehanna; Huntingdon & Broad Top Mountain; Reynoldsville & Falls Creek; Washington Run.	878, 263		
		15, 244, 365	16, 438, 539	92. 7
Tennessee	Louisville & Nashville	110		
	Nashville, Chattanooga & St. Louis	28, 476		
	Southern	14, 277		
		42, 863	180, 351	23. 8
Utah	Denver & Rio Grande Western	233, 095	232, 941	100. 1
Virginia	Chesapeake & Ohio	1, 270		
	Interstate	431, 490		
	Louisville & Nashville	34, 315		
	Norfolk & Western	224, 061		
	Southern	38, 000		
		729, 136	774, 887	94. 1
Washington	Northern Pacific	37, 987	37, 987	100. 0
West Virginia	Baltimore & Ohio	221, 265		
	Chesapeake & Ohio	215, 468		
	New York Central	163, 936		
	Norfolk & Western	148, 279		
	Western Maryland	42, 246		
		791, 194	821, 909	96. 3
	Total railroad shipments	17, 785, 814		
	Total waterway shipments (Monongahela River, Pa.)	368, 208	(b)	2. 2
	Grand total	18, 154, 022	19, 379, 870	93. 7

[a] Excess of shipments over production represents inclusion of screenings or withdrawal from stock.
[b] Production shown above.

TABLE 53.—*Beehive coke loaded for shipment on originating railroads and waterways in the United States, 1922–23, by routes, in net tons, as reported by the coke producers*

Route	State	Quantity		Percentage of total
		By States	Total	
1922				
Railroads:				
Baltimore & Ohio	Pennsylvania	721,657	888,367	10.9
	West Virginia	166,710		
Baltimore & Ohio; Pittsburgh & Lake Erie	Ohio	104,968	104,968	1.3
Buffalo, Rochester & Pittsburgh	Pennsylvania	62,171	62,171	.8
Buffalo & Susquehanna; Reynoldsville & Falls Creek; Washington Run.	do	256,849	256,849	3.1
Central of Georgia	Georgia	8,767	8,767	.1
Chesapeake & Ohio	Kentucky	6,230	106,686	1.4
	Virginia	4,275		
	West Virginia	96,181		
Colorado & Wyoming	Colorado	47,460	47,460	.6
Denver & Rio Grande Western	do	71,734	244,187	3.0
	Utah	172,453		
El Paso & Southwestern	New Mexico	87,631	87,631	1.1
Interstate	Virginia	270,957	270,957	3.3
Kanawha & Michigan	West Virginia	57,315	57,315	.7
Ligonier Valley	Pennsylvania	60,306	60,306	.7
Louisville & Nashville	Alabama	121,685	150,121	1.9
	Kentucky	24,292		
	Tennessee	340		
	Virginia	3,804		
Louisville & Nashville; Norfolk & Western; Southern.	do	27,768	27,768	.3
Monongahela	Pennsylvania	1,047,200	1,047,200	12.9
Nashville, Chattanooga & St. Louis	Tennessee	13,703	13,703	.1
Norfolk & Western	Virginia	31,104	113,033	1.4
	West Virginia	81,929		
Northern Pacific	Washington	25,651	25,651	.3
Pennsylvania	Pennsylvania	4,185,962	4,185,962	51.5
Pittsburgh & Lake Erie	do	88,375	88,375	1.1
St. Louis-San Francisco	Alabama	80	80	----------
Southern	do	65,549	104,953	1.3
	Tennessee	420		
	Virginia	38,984		
Western Maryland	West Virginia	14,994	14,994	.2
Total railroad shipments		7,967,504	7,967,504	98.0
Waterways: Monongahela River	Pennsylvania	165,791	165,791	2.0
Grand total		8,133,295	8,133,295	100.0
1923				
Railroads:				
Baltimore & Ohio	Pennsylvania	1,800,525	2,021,790	11.1
	West Virginia	221,265		
Buffalo, Rochester & Pittsburgh	Pennsylvania	131,678	131,678	.7
Buffalo & Susquehanna; Huntingdon & Broad Top Mountain; Reynoldsville & Falls Creek; Washington Run.	do	878,263	878,263	4.8
Central of Georgia	Georgia	12,112	12,112	.1
Chesapeake & Ohio	Kentucky	12,704	229,442	1.3
	Virginia	1,270		
	West Virginia	215,468		
Chicago, Rock Island & Pacific; El Paso & Southwestern.	Oklahoma and New Mexico	138,212	138,212	.7
Colorado & Southern	Colorado	34,816	34,816	.2
Colorado & Wyoming	do	93,953	93,953	.5
Denver & Rio Grande Western	do	71,153	304,248	1.7
	Utah	233,095		
Interstate	Virginia	431,490	431,490	2.3
Ligonier Valley	Pennsylvania	207,583	207,583	1.2
Louisville & Nashville	Alabama	199,955	345,786	1.9
	Kentucky	111,406		
	Tennessee	110		
	Virginia	34,315		
Monongahela	Pennsylvania	3,834,004	3,834,004	21.1
Nashville, Chattanooga & St. Louis	Tennessee	28,476	28,476	.2
New York Central	West Virginia	163,936	163,936	.9
Norfolk & Western	Virginia	224,061	372,340	2.1
	West Virginia	148,279		
Northern Pacific	Washington	37,987	37,987	.2
Pennsylvania	Pennsylvania	[illegible],167,495	[illegible],167,495	45.0
Pittsburgh & Lake Erie	do	224,817	224,817	1.3

TABLE 53.—*Beehive coke loaded for shipment on originating railroads and waterways in the United States, 1922–23, by routes, in net tons, as reported by the coke producers*—Continued

Route	State	Quantity		Percentage of total
		By States	Total	
1923				
Railroads—Continued.				
St. Louis-San Francisco	Alabama	115	115	
Southern	do	32,748	85,025	0.5
	Tennessee	14,277		
	Virginia	38,000		
Western Maryland	West Virginia	42,246	42,246	.2
Total railroad shipments		17,785,814	17,785,814	98.0
Waterways: Monongahela River		368,208	368,208	2.0
Grand total		18,154,022	18,154,022	100.0

TABLE 54.—*By-product coke loaded for shipment on originating railroads and waterways in the United States in 1923, by States, in net tons, as reported by the coke producers*

State	Route	Shipments	Production	Percentage of production shipped
	Railroads			
Alabama	Birmingham Southern	354,504		
	Illinois Central	26,410		
	Louisville & Nashville	559,855		
	St Louis-San Francisco	3,302		
	Southern	715,025		
	Mobile & Ohio; Southern; Louisville & Nashville.	204,455		
	Southern; Louisville & Nashville	648		
		1,864,199	4,385,366	42.5
Colorado	Colorado & Wyoming	34,772	448,243	7.8
Illinois	Belt Railway of Chicago	224,284		
	Chicago & Illinois Western	48,761		
	Chicago Short Line	660,091		
	Chicago, West Pullman & Southern	6,595		
	Elgin, Joliet & Eastern	602,894		
	Illinois Central	20		
	Illinois Central; Wabash; Chicago, Burlington & Quincy; Chicago & Alton.	198,252		
		1,740,897	3,187,168	54.6
Indiana	Chicago, Milwaukee & St. Paul	151,436		
	Elgin, Joliet & Eastern	851,894		
	Pennsylvania	3,845		
	Cleveland, Cincinnati, Chicago & St. Louis	183,943		
		1,191,118	5,042,614	23.6
Massachusetts	Boston & Albany	257,719		
	Boston & Maine	137,112		
		394,831	554,125	71.2
Michigan	Detroit & Toledo Short Line	11,235		
	Detroit, Toledo & Ironton	2,065		
	Michigan Central	56,822		
		70,122	1,648,773	4.3

TABLE 54.—*By-product coke loaded for shipment on originating railroads and waterways in the United States in 1923, by States, in net tons, as reported by the coke producers*—Continued

State	Route	Shipments	Production	Percentage of production shipped
	Railroads—Continued			
Minnesota	Great Northern	107,507		
	Northern Pacific	107,507		
	Northern Pacific; Great Northern; Chicago, Milwaukee & St. Paul; Chicago, St. Paul, Minneapolis & Omaha.	22,316		
		237,330	695,824	34.1
New Jersey	Delaware, Lackawanna & Western	62,527		
	Erie	104,971		
		167,498	897,569	18.7
New York	Delaware, Lackawanna & Western	297,225		
	Lehigh Valley	5,358		
	New York Central	137,194		
	South Buffalo	365,577		
		805,354	1,783,948	45.1
Ohio	Baltimore & Ohio	194,379		
	Newburgh & South Shore	781,132		
	New York Central	75,427		
	Norfolk & Western	377,423		
	Pennsylvania	1,492		
	Toledo Terminal	46,615		
	Wheeling & Lake Erie	1,865		
		1,478,333	6,323,810	23.4
Pennsylvania	Lehigh Valley	100,526		
	Mercer Valley	201,062		
	Pennsylvania	419,197		
	Philadelphia & Reading	323,030		
	Union (Pittsburgh)	3,028,183		
	Upper Merion & Plymouth	503,221		
	Baltimore & Ohio and Pennsylvania	82,735		
		4,657,954	9,185,747	50.7
Tennessee	Southern	113,032	124,160	91.0
Washington	Northern Pacific	2,443	31,081	7.9
West Virginia	Baltimore & Ohio	208,446		
	Pennsylvania	124,886		
		333,332	940,866	35.4
Kentucky, Missouri, Rhode Island, and Wisconsin.	Chesapeake & Ohio; Chicago, Milwaukee & St. Paul; Chicago & Northwestern; Minneapolis, St. Paul & Sault Ste. Marie; Missouri Pacific; New York, New Haven & Hartford.	1,220,385	1,486,702	82.1
	Total railroad shipments	14,311,600		
	Waterways			
Maryland	Patapsco River	126,139	861,668	14.6
Massachusetts	Mystic River	25,075	([a])	4.5
New Jersey	Hackensack River	407,608		45.4
Wisconsin	Lake Michigan	952		([b])
	Total waterway shipments	559,774		
	Grand total	14,871,374	37,597,664	39.5

[a] Figures given under respective States above.
[b] Survey not at liberty to publish.

TABLE 55.—*By-product coke loaded for shipment on originating railroads and waterways in the United States in 1923, by routes, in net tons, as reported by the coke producers*

Route	State	Quantity		Percentage of total
		By States	Total	
Railroads:				
Baltimore & Ohio	Ohio	194,379	402,825	2.7
	West Virginia	208,446		
Belt Railway of Chicago	Illinois	224,284	224,284	1.5
Birmingham Southern	Alabama	354,504	354,504	2.4
Boston & Albany	Massachusetts	257,719	257,719	1.7
Boston & Maine	do	137,112	137,112	.9
Chicago & Illinois Western	Illinois	48,761	48,761	.3
Chicago, Milwaukee & St. Paul	Indiana and Wisconsin.	506,914	506,914	3.4
Chicago Short Line	Illinois	660,091	660,091	4.4
Chicago, West Pullman & Southern	do	6,595	6,595	.1
Cleveland, Cincinnati, Chicago & St. Louis	Indiana	183,943	183,943	1.2
Colorado & Wyoming	Colorado	34,772	34,772	.2
Delaware, Lackawanna & Western	New Jersey	62,527	359,752	2.4
	New York	297,225		
Detroit & Toledo Shore Line	Michigan	11,235	11,235	.1
Detroit, Toledo & Ironton	do	2,065	2,065	
Elgin, Joliet & Eastern	Illinois	602,894	1,454,788	9.9
	Indiana	851,894		
Erie	New Jersey	104,971	104,971	.7
Great Northern	Minnesota	107,507	107,507	.7
Illinois Central	Alabama	26,410	26,430	.2
	Illinois	20		
Lehigh Valley	New York	5,358	105,884	.7
	Pennsylvania	100,526		
Louisville & Nashville	Alabama	559,855	559,855	3.8
Mercer Valley	Pennsylvania	201,062	201,062	1.4
Michigan Central	Michigan	56,822	56,822	.4
Newburgh & South Shore	Ohio	781,132	781,132	5.3
New York Central	New York	137,194	212,621	1.4
	Ohio	75,427		
Norfolk & Western	do	377,423	377,423	2.5
Northern Pacific	Minnesota	107,507	109,950	.7
	Washington	2,443		
Pennsylvania	Indiana	3,845	549,420	3.7
	Ohio	1,492		
	Pennsylvania	419,197		
	West Virginia	124,886		
Philadelphia & Reading	Pennsylvania	323,030	323,030	2.1
St. Louis-San Francisco	Alabama	3,302	3,302	
South Buffalo	New York	365,577	365,577	2.5
Southern	Alabama	715,025	828,057	5.6
	Tennessee	113,032		
Toledo Terminal	Ohio	46,615	46,615	.3
Union (Pittsburgh)	Pennsylvania	3,028,183	3,028,183	20.5
Upper Merion & Plymouth	do	503,221	503,221	3.4
Wheeling & Lake Erie	Ohio	1,865	1,865	
Baltimore & Ohio and Pennsylvania	Pennsylvania	82,735	82,735	.5
Illinois Central; Wabash; Chicago, Burlington & Quincy; Chicago & Alton.	Illinois	198,252	198,252	1.3
Mobile & Ohio; Southern; Louisville & Nashville.	Alabama	204,455	204,455	1.4
Northern Pacific; Great Northern; Chicago, Milwaukee & St. Paul; Chicago, St. Paul, Minneapolis & Omaha.	Minnesota	22,316	22,316	.1
Southern; Louisville & Nashville	Alabama	648	648	
Chesapeake & Ohio; Chicago & Northwestern; Minneapolis, St. Paul & Sault Ste. Marie; Missouri Pacific; New York, New Haven & Hartford.	Kentucky, Missouri, Rhode Island, and Wisconsin.	864,907	864,907	5.8
Total railroad shipments		14,311,600	14,311,600	96.2
Waterways:				
Hackensack River	New Jersey	407,608	407,608	2.7
Lake Michigan	Wisconsin	952	952	
Mystic River	Massachusetts	25,075	25,075	.2
Patapsco River	Maryland	126,139	126,139	.9
Total waterway shipments		559,774	559,774	3.8
Grand total		14,871,374	14,871,374	100.0

WORLD PRODUCTION

TABLE 56.—*Coke produced in the principal countries of the world, 1913 and 1920–1923*

[In metric tons of 2,204.6 pounds. Gas-house coke is not included]

Country	1913	1920	1921	1922	1923
Australia:					
New South Wales	303,405	576,678	601,600	244,085	589,689
Queensland	15,182	19,968	7,412	5,388	5,330
Austria	2,598,782	([a])	([a])	([a])	([a])
Belgium	3,523,000	1,835,400	1,402,610	2,849,884	4,179,964
Canada	1,388,438	1,152,411	917,927	635,115	1,061,391
China (exports)	([b])	19,103	35,157	44,385	27,170
Czechoslovakia	([c])	1,590,623	1,135,837	639,290	1,474,531
France	4,027,424	1,761,418	1,860,706	2,362,280	1,985,735
Germany [d]	35,065,847	26,720,535	29,078,013	31,022,480	12,836,004
Hungary	160,073	([b])	([b])	([b])	([b])
India—British [e]	([b])	365,465	276,927	327,676	307,764
Italy	498,442	95,727	34,022	167,953	275,235
Japan:					
Japan proper—					
Natural coke	129,101	67,172	64,365	([b])	118,201
Metallurgical	([b])	903,225	668,550	720,554	658,053
Taiwan	([b])	([b])	32,000	([b])	([b])
Netherlands	----------	138,987	228,605	247,315	267,639
Peru	([b])	([b])	([b])	([b])	45,000
Poland	([f])	([f])	([f])	[g] 678,972	1,376,194
Rhodesia (Southern)	20,137	95,526	116,316	97,670	122,897
Russia (Donetz Basin)	4,437,000	10,000	104,025	112,333	([b])
Spain	595,677	280,717	446,087	311,423	651,966
Union of South Africa	8,478	20,813	22,638	36,823	53,750
United Kingdom [h]	13,004,420	12,813,849	4,647,382	9,180,765	13,633,678
United States	42,002,008	46,579,196	22,940,425	33,678,161	51,688,879

[a] See Czechoslovakia.

[b] Data not available.

[c] See Austria.

[d] Includes all of Upper Silesia in 1913, 1920–21, and January–May, 1922; German Upper Silesia, June–December, 1922; and Saar in all five years.

[e] Represents only coke made at collieries.

[f] See Germany.

[g] July–December. Included under Germany from January to May.

[h] In Great Britain the production of gas-house coke, not included above, is especially important and was as follows: 1913, 7,956,419 metric tons; 1920, 8,440,471 tons; 1921, 6,907,608 tons; 1922, 7,861,908 tons; 1923, 7,663,930 tons.

COKE-OVEN BY-PRODUCTS, SUMMARY TABLES

TABLE 57.—*By-products obtained from coke-oven operations in the United States, 1922–23*

Product	Production	Sales		
		Quantity	Value	
			Total	Average
1922				
Tar gallons	327,779,734	162,204,417	$6,419,743	$0.0396
Ammonia:				
Sulphate pounds	695,543,349	714,752,882	17,818,236	.0249
Ammonia liquor (NH_3 content) do	50,036,646	48,523,937	4,559,535	.0940
Other forms (NH_3 content) do	693,782	192,549	12,041	.0625
	----------	----------	22,389,812	----------
Sulphate equivalent of all forms do	898,465,061	909,618,826	----------	----------
Gas:				
Used under boilers, etc M cubic feet	[a]442,671,114	19,123,814	1,251,325	.0654
Used in steel or affiliated plants do		144,976,030	15,942,446	.1100
Distributed through city mains do		56,930,253	20,326,648	.3570
Sold for industrial use do		10,352,921	1,104,901	.1066
	----------	231,383,018	38,625,320	.1669

[a] Includes gas wasted and gas used for heating retorts

TABLE 57.—*By-products obtained from coke-oven operations in the United States, 1922–23*—Continued

Product	Production	Sales		
		Quantity	Value	
			Total	Average
1922				
Light oil and derivatives:				
Crude light oil .... gallons	[b] 101, 437, 555	5, 138, 095	$630, 768	$0. 1228
Benzol, crude .... do	2, 666, 177	2, 665, 889	698, 437	. 2620
Benzol, refined .... do	10, 419, 504	9, 590, 459	2, 736, 944	. 2854
Motor benzol .... do	57, 025, 699	54, 930, 203	10, 491, 309	. 1916
Toluol, crude .... do	38, 159	3, 938	652	. 1650
Toluol, refined .... do	1, 955, 119	1, 906, 122	556, 363	. 2919
Solvent naphtha .... do	2, 983, 858	2, 861, 482	538, 512	. 1882
Other light-oil products .... do	580, 058	212, 712	14, 949	. 0703
	[c] 75, 668, 574	77, 308, 900	15, 667, 934	. 2027
Naphthalene:				
Crude .... pounds	6, 107, 742	3, 298, 851	52, 103	. 0158
Refined .... do	1, 810, 972	1, 589, 084	79, 149	. 0498
	7, 918, 714	4, 887, 935	131, 252	. 0269
Other products	....	....	154, 507	....
Value of all by-products sold	....	....	83, 388, 568	....
1923				
Tar .... gallons	440, 907, 109	211, 739, 469	9, 250, 552	. 044
Ammonia:				
Sulphate .... pounds	915, 926, 762	884, 952, 912	25, 954, 413	. 029
Ammonia liquor (NH_3 content) [d] .... do	58, 699, 902	57, 859, 699	5, 754, 463	. 099
	....	....	31, 708, 876	....
Sulphate equivalent of all forms .... do	1, 150, 726, 370	1, 116, 391, 708	....	....
Gas:				
Used under boilers, etc .... M cubic feet	[a]601, 155, 293	33, 740, 758	1, 820, 808	. 054
Used in steel or affiliated plants .... do		200, 099, 200	22, 646, 134	. 113
Distributed through city mains .... do		65, 143, 515	23, 116, 578	. 355
Sold for industrial use .... do		19, 458, 781	4, 025, 700	. 207
	....	318, 442, 254	51, 609, 220	. 162
Light oil and derivatives:				
Crude light oil .... gallons	[e] 135, 647, 175	6, 539, 368	683, 545	. 105
Benzol, crude .... do	4, 503, 428	4, 348, 400	768, 486	. 177
Benzol, refined .... do	12, 364, 043	12, 375, 782	3, 070, 751	. 248
Motor benzol .... do	80, 467, 883	80, 480, 326	13, 145, 833	. 163
Toluol, crude .... do	37, 777	6, 097	978	. 160
Toluol, refined .... do	2, 847, 517	2, 628, 686	765, 052	. 291
Solvent naphtha .... do	4, 162, 178	3, 399, 904	608, 084	. 179
Other light-oil products .... do	439, 253	198, 098	10, 605	. 054
	[c] 104, 822, 079	109, 976, 661	19, 053, 334	. 173
Naphthalene:				
Crude .... pounds	11, 872, 007	10, 047, 427	174, 216	. 017
Refined .... do	1, 139, 922	1, 198, 206	65, 483	. 055
	13, 011, 929	11, 245, 633	239, 699	. 021
Other products	....	....	214, 264	....
Value of all by-products sold	....	....	112, 075, 945	....

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[a] Includes gas wasted and gas used for heating retorts.

[b] Of the crude light oil 98,432,100 gallons, including 4,200,000 gallons of purchased oil, was refined on the premises to make the derived products listed.

[c] Total gallons of derived products.

[d] Includes an unknown amount of sulphate sold on the basis of pounds of NH_3 content.

[e] Of the crude light oil 132,517,389 gallons was refined on the premises to make the derived products listed.

TABLE 58.—*Value of by-products and of coke, including breeze, per ton of coke produced in the United States, 1914–1923*

Product	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Ammonia and its compounds	$0.68	$0.70	$0.74	$0.79	$1.02	$1.06	$1.16	$0.84	$0.78	$0.84
Light oil and its derivatives (including naphthalene)	([a])	.52	1.58	1.30	.99	.50	.61	.59	.55	.51
Surplus gas sold or used	.54	.61	.57	.51	.53	.66	1.05	1.31	1.35	1.37
Tar	.26	.25	.26	.25	.24	.28	.21	.29	.22	.25
Miscellaneous products	.09	.03	.01	.06	.09	.03	.01	.01	.01	.01
	1.57	2.11	3.16	2.91	2.87	2.53	3.04	3.04	2.91	2.98
Tar used	([b])	([b])	([b])	([b])	.08	.09	.22	.26	.23	.26
Breeze produced	([c])	([c])	.09	.10	.12	.10	.14	.16	.18	.24
Total value of by-products, including those not sold	1.65	2.19	3.25	3.01	3.07	2.72	3.40	3.46	3.32	3.48
Value of coke produced	3.39	3.45	3.95	6.18	[d] 7.42	[d] 6.37	[d] 10.15	[d] 5.95	[d] 6.59	[d] 6.85
Total value of coke and by-products	5.04	5.64	7.20	9.19	10.49	9.09	13.55	9.41	9.91	10.33

[a] Included under "Miscellaneous products."
[b] Included in tar sold.
[c] Estimate included in total.
[d] The average receipts per ton of coke sold during these years were $7.88 in 1918, $6.58 in 1919, $10.77 in 1920, $7.72 in 1921, $8.45 in 1922, and $8.53 in 1923.

TABLE 59.—*Average receipts per unit of coke-oven by-products sold, 1913–1923*

[The figures in this table for 1913 to 1917 represent "average value of by-products produced and sold." For 1918 to 1922 they represent "average receipts from sales." The two sets of figures are probably comparable for practical purposes]

	Tar	Sulphate	Surplus gas	Benzol, refined	Motor benzol	Toluol, refined	Solvent naphtha	Naphthalene	
								Crude	Refined
Unit	Gallon	Pound	M cubic feet	Gallon	Gallon	Gallon	Gallon	Pound	Pound
	Cents	*Cents*	*Cents*	*Cents*	*Cents*		*Cents*	*Cents*	
1913	2.5	3.1	8.8	[a] 27	([b])	[a] $0.29	[a] 25	([b])	
1914	2.6	2.8	9.8	[a] 26	([b])	[a] .33	[a] 25	([b])	
1915	2.6	2.8	10.2	56.8	([c])	2.45	24.0	[d] 10.0	
1916	2.6	3.1	9.8	62.4	([c])	2.85	28.4	[d] 3.4	
1917	2.7	3.4	8.7	45.0	([c])	1.37	16.6	[d] 3.3	
1918	3.2	4.5	8.7	27.5	([c])	1.43	14.1	2.8	6.6
1919	3.2	3.8	8.6	20.6	([e])	.263	15.2	2.0	4.1
1920	3.7	4.3	14.0	26.0	22.7	.300	18.1	2.7	6.1
1921	4.2	2.5	16.8	23.9	16.6	.283	17.7	2.5	5.6
1922	4.0	2.5	16.7	28.5	19.2	.292	18.8	1.6	5.0
1923	4.4	2.9	16.2	24.8	16.3	.291	17.9	1.7	5.5

[a] Trade quotations, New York market; used to avoid disclosing individual operators' reports.
[b] No data.
[c] Not reported during the war.
[d] Crude and refined not separated prior to 1918.
[e] Data uncertain.

TABLE 60.—*Average yield of coke and by-products per net ton of coal charged in by-product ovens in the United States, 1916–1923*

Product	1916	1917	1918	1919	1920	1921	1922	1923
Coke……pounds	1,438	1,424	1,410	1,402	1,395	1,376	1,390	1,386
Tar……gallons	7.0	7.0	7.1	8.1	8.2	8.8	8.0	8.1
Ammonium sulphate (or equivalent)……pounds	17.7	17.8	18.9	20.8	21.4	22.8	21.9	21.2
Light oil……gallons	([a])	([a])	2.4	2.7	[b] 2.7	[b] 2.8	[b] 2.7	[b] 2.7
Gas:								
Total……M cubic feet	11.0	10.7	10.4	11.6	10.8	10.8	10.8	11.1
Surplus sold or used……do	4.2	4.1	4.3	5.4	5.2	5.4	5.6	5.9
Burned in coking process……do	6.4	6.0	5.7	5.9	5.4	5.1	5.0	5.0
Wasted……do	.4	.6	.4	.3	.2	.3	.2	.2

[a] Records not comparable.

[b] Average for plants now recovering light oil.

TAR

TABLE 61.—*Coke-oven, coal-gas, water-gas, and oil-gas tar produced and sold in the United States, 1918–1923*

[The difference between production and sales is accounted for by tar used by the producer, and by changes in stock]

	Coke-oven tar	Coal-gas tar	Total coal tar	Water and oil gas tar
Production (gallons):				
1918	263,299,470	52,694,826	315,994,296	100,985,156
1919	288,901,739	([a])	340,900,000	([b])
1920	360,664,124	51,264,956	411,929,080	116,073,907
1921	253,051,649	([a])	303,000,000	([b])
1922	327,779,734	48,082,228	375,861,962	104,555,028
1923	440,907,109	([a])	488,900,000	([b])
Sales:				
Quantity (gallons)—				
1918	200,233,002	47,727,839	247,960,841	55,283,484
1919	217,707,157	([a])	264,900,000	([b])
1920	174,363,696	46,604,133	220,967,829	59,238,730
1921	135,293,047	([a])	179,200,000	([b])
1922	162,204,417	41,266,074	203,470,491	47,338,489
1923	211,739,469	([a])	254,700,000	[c] 49,990,840
Value—				
1918	$6,364,972	$1,863,580	$8,228,552	$1,805,865
1919	6,918,549	([a])	8,800,000	([b])
1920	6,378,040	2,010,186	8,388,226	2,109,388
1921	5,645,309	([a])	7,760,000	([b])
1922	6,419,743	1,955,950	8,375,693	1,879,490
1923	9,250,552	([a])	11,400,000	[c] 2,001,363

[a] No report. Estimate included in total.

[b] No report.

[c] As reported by Bureau of the Census, Department of Commerce.

TABLE 62.—*Disposal of coke-oven tar produced in the United States, 1922–23, in gallons*

	1922			1923		
	Furnace plants	Other plants	Total	Furnace plants	Other plants	Total
Sold	109,500,273	52,704,144	162,204,417	137,761,447	73,978,022	211,739,469
Used:						
As fuel under boilers	9,806,520	307,282	10,113,802	9,843,154	…………	9,843,154
In open-hearth or other metallurgical plants	151,797,400	1,143	151,798,543	212,287,166	…………	212,287,166

TABLE 63.—*Coke-oven tar produced and sold in the United States in 1923*

State	Produced (gallons)		Sold			Used (gallons)			On hand Dec. 31 (gallons)
	Total	Per ton of coal coked	Gallons	Value		As fuel under boilers	In open-hearth or affiliated plants	Otherwise	
				Total	Average				
Alabama	53, 054, 086	8. 3	32, 143, 078	$1, 264, 192	$0. 039	392, 748	20, 008, 033	192, 847	2, 702, 295
Colorado	6, 579, 500	10. 1	9, 861	(a)	(a)	----------	6, 405, 760	107, 183	109, 665
Illinois	33, 683, 519	7. 3	25, 911, 542	1, 115, 123	. 043	----------	7, 914, 785	24, 229	1, 384, 679
Indiana	44, 388, 998	6. 2	5, 298, 753	254, 541	. 048	----------	39, 066, 193	----------	2, 745, 198
Maryland	8, 201, 024	7. 0	8, 300, 645	(a)	(a)	----------	----------	103	1, 099, 949
Massachusetts	6, 325, 728	7. 9	5, 604, 388	(a)	(a)	----------	----------	----------	1, 533, 867
Michigan	16, 262, 598	7. 1	8, 643, 336	437, 288	. 051	6, 086, 612	----------	886, 000	2, 087, 369
Minnesota	7, 661, 025	7. 7	5, 383, 151	229, 301	. 043	----------	2, 297, 905	105, 208	333, 793
New Jersey	9, 507, 327	7. 9	9, 507, 203	(a)	(a)	----------	----------	----------	90, 307
New York	22, 561, 314	8. 7	17, 555, 253	691, 574	. 039	----------	3, 824, 558	40, 093	2, 389, 518
Ohio	78, 679, 278	8. 5	43, 798, 775	2, 253, 747	. 051	----------	34, 058, 881	----------	4, 186, 239
Pennsylvania	121, 522, 057	9. 1	19, 569, 138	807, 637	. 041	3, 363, 794	96, 734, 128	4, 051	6, 085, 873
Tennessee	1, 382, 500	2. 6	1, 412, 609	35, 615	. 025	----------	----------	----------	81, 156
Washington	401, 228	7. 3	381, 642	26, 715	. 070	----------	----------	525	21, 606
West Virginia	15, 001, 436	10. 7	12, 924, 893	559, 543	. 043	----------	1, 976, 893	----------	809, 154
Missouri, Rhode Island, and Wisconsin	15, 695, 491	7. 5	15, 295, 202	650, 555	. 043	----------	----------	200	1, 197, 306
Undistributed	----------	----------	----------	924, 721	. 039	----------	----------	----------	----------
	440, 907, 109	8. 1	211, 739, 469	9, 250, 552	. 044	9, 843, 154	212, 287, 166	1, 360, 439	26, 857, 974

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[a] Included under "Undistributed."

TABLE 64.—*Yield of tar from coke-oven plants, 1921–1923*

	1921	1922	1923
Total production of tar......gallons..	253, 051, 649	327, 779, 734	440, 907, 109
Yield obtained per ton of coal coked:			
At plant reporting minimum average yield......do....	5. 1	4. 0	2. 6
At plant reporting maximum average yield......do....	17. 0	13. 3	13. 2
At average plant [a]......do....	8. 8	8. 1	8. 3
Average yield for all coal coked [b]......do....	8. 8	8. 0	8. 1
Total number of plants producing tar	67	64	65
Number producing—			
Less than 7 gallons of tar per ton of coal	11	14	11
7–7.99 gallons	12	15	19
8–8.99 gallons	11	12	9
9–9.99 gallons	16	15	12
10–10.99 gallons	9	6	10
11–11.99 gallons	4		
12 gallons or more	4	2	4

[a] Sum of averages for all plants divided by number of plants.
[b] Total tar recovered at all plants divided by number of tons of coal coked.

AMMONIA

TABLE 65.—*Ammonia produced at coke-oven plants in the United States in 1923, in pounds*

State	Sulphate	Liquor (NH_3 content)	Sulphate equivalent of all forms	
			Total	Per ton of coal coked
Alabama	141, 140, 753	426, 807	142, 847, 981	22. 3
Colorado	14, 096, 394		14, 096, 394	21. 6
Illinois	66, 051, 434	5, 479, 406	87, 969, 058	19. 2
Indiana	80, 956, 045	9, 057, 019	117, 184, 121	16. 4
Maryland	23, 352, 566		23, 352, 566	19. 9
Massachusetts	14, 232, 000		14, 232, 000	17. 8
Michigan	18, 265, 922	8, 420, 666	51, 948, 586	22. 7
Minnesota	13, 774, 910	1, 323, 215	19, 067, 770	19. 1
New Jersey	22, 256, 000	1, 354, 152	27, 672, 608	22. 9
New York	35, 776, 995	5, 044, 572	55, 955, 283	21. 5
Ohio	174, 347, 685	9, 762, 288	213, 396, 837	23. 0
Pennsylvania	280, 718, 656	4, 181, 008	297, 442, 688	22. 2
Tennessee	3, 718, 241		3, 718, 241	21. 6
Washington		457, 312	1, 829, 248	33. 3
West Virginia	27, 239, 161	1, 695, 645	34, 021, 741	24. 3
Kentucky, Missouri, Rhode Island, and Wisconsin		11, 497, 812	45, 991, 248	22. 1
	915, 926, 762	58, 699, 902	1, 150, 726, 370	21. 2

TABLE 66.—*Yield of ammonium sulphate equivalent reported by coke-oven plants, 1921–1923*

	1921	1922	1923
Total ammonium sulphate or equivalent recovered..pounds..	657, 001, 003	898, 465, 061	1, 150, 726, 370
Yield of sulphate per ton of coal coked:			
At plant reporting minimum average yield......do....	3. 6	14. 2	11. 6
At plant reporting maximum average yield......do....	30. 3	29. 9	33. 3
At average plant [a]......do....	21. 9	22. 1	21. 2
Average yield for all coal coked [b]......do....	22. 8	21. 9	21. 2
Total number of plants reporting recovery of ammonia	67	64	65
Number of plants recovering:			
Less than 10 pounds per ton of coal	2		
10–14.9 pounds	2	2	3
15–19.9 pounds	14	14	15
20–21.9 pounds	11	13	16
22–23.9 pounds	13	17	14
24–25.9 pounds	15	10	9
26–27.9 pounds	3	5	7
28–29.9 pounds	6	3	
30 pounds or more	1		1

[a] Sum of averages for all plants divided by number of plants.
[b] Total yield in sulphate equivalent divided by number of tons of coal carbonized.

TABLE 67.—*Ammonia sold by coke-oven plants in the United States in 1923*

State	Sulphate			Liquor (NH_3 content)			Total (sulphate equivalent of all forms)	
	Pounds	Value		Pounds	Value		Pounds	Value
		Total	Average		Total	Average		
Alabama	131,094,010	$3,999,978	$0.031	399,197	$39,919	$0.100	132,690,798	$4,039,897
Colorado	13,636,000	(a)	(a)				13,636,000	(a)
Illinois	59,644,375	1,755,053	.029	5,568,804	607,640	.109	81,919,591	2,362,693
Indiana	71,864,719	2,117,679	.029	8,349,649	827,444	.099	105,263,315	2,945,123
Maryland	21,574,950	(a)	(a)				21,574,950	(a)
Massachusetts	14,146,000	467,313	.033				14,146,000	467,313
Michigan	25,654,594	692,674	.027	8,504,325	852,611	.100	59,671,894	1,545,285
Minnesota	12,917,100	395,227	.031	1,340,687	128,996	.096	18,279,848	524,223
New Jersey	22,904,000	(a)	(a)	1,354,152	(a)	(a)	28,320,608	(a)
New York	34,296,284	1,026,528	.030	5,126,224	464,288	.091	54,801,180	1,490,816
Ohio	171,707,275	5,019,860	.029	9,549,632	982,859	.103	209,905,803	6,002,719
Pennsylvania	275,049,710	7,791,138	.028	3,942,336	367,838	.093	290,819,054	8,158,976
Tennessee	3,759,700	115,389	.031				3,759,700	115,389
Washington				454,552	38,061	.083	1,818,208	38,061
West Virginia	26,704,195	765,361	.028	1,661,860	166,186	.100	33,351,635	931,547
Kentucky, Missouri, Rhode Island, and Wisconsin				11,608,281	1,146,846	.099	46,433,124	1,146,846
Undistributed		1,808,213	.031		131,775	.097		1,939,988
	884,952,912	25,954,413	.029	57,859,699	5,754,463	.099	1,116,391,708	31,708,876

[a] Included under "Undistributed."

TABLE 68.—*Average monthly prices of sulphate of ammonia per 100 pounds, 1909–1923*

[Quotations, 1909–1916, abstracted from Oil, Paint, and Drug Reporter, at New York; 1917 to date, from Iron Trade Review, f. o. b. producers' works. Compiled by C. G. Atwater, of the Barrett Co.]

	1909	1910	1911	1912	1913	1914	1915	1916
January	$2.91	$2.73	$2.97½	$3.20¾	$3.28	$2.90	$2.71¼	$3.96½
February	2.99	2.73¾	3.08¾	3.24¼	3.30	2.85	2.98¾	3.96¼
March	2.98¼	2.83¾	3.11¼	3.28	3.30	2.85	3.16	3.92½
April	2.97¼	2.77	3.11¼	3.38	3.30	2.85	3.10⅝	3.68¾
May	2.91	2.82	3.07½	3.40	3.30	2.70	3.20	3.57½
June	2.90	2.78¾	3.03¾	3.40	3.12	2.55	3.22½	3.53
July	2.88	2.78¾	3.07¼	3.25	3.00	2.52	3.41	3.43½
August	2.75½	2.79¼	3.16¼	3.22½	2.98	2.60	3.53	3.58¾
September	2.65	2.87½	3.16¼	3.29	3.07	2.76⅞	3.37½	3.77½
October	2.65	2.92½	3.18	3.28	3.10	2.67½	3.37½	4.02½
November	2.62½	2.93¾	3.18	3.20⅝	3.06¼	2.67½	3.57	4.21¼
December	2.64	2.96¼	3.20	3.22½	2.95	2.67½	3.93¾	4.32½
Average	2.82	2.83	3.11	3.28	3.14	2.71	3.30	3.83

	1917	1918	1919	1920	1921	1922	1923
January	$4.12	$5.03	$4.68	$4.00	$3.37½	$2.20	$3.10
February	4.18	5.22½	4.50	4.00	3.12½	2.35	3.15⅝
March	(a)	5.40½	4.25	4.55	2.92½	2.60½	3.19½
April	(a)	5.46	4.00	4.55	2.57½	2.65	3.22½
May	4.72½	5.59½	3.80	4.55	2.45	2.67	3.21½
June	4.80	5.10	3.60	4.55	2.45	2.72	3.13¾
July	4.90	4.50	3.40	4.55	2.35	2.82	3.10
August	4.90	4.50	3.53	4.80	2.00	2.82	3.07½
September	4.92½	4.50	3.53	4.80	1.95	2.90	3.02½
October	4.95	4.50	3.57	4.25	2.20	3.05	3.01¼
November	4.92½	4.50	3.78	3.75	2.20	3.07	2.93¾
December	4.90	4.86	3.93	3.38	2.20	3.12	2.76¼
Average	4.73	4.93	3.88	4.31	2.48	2.75	3.08

[a] No market.

BENZOL AND LIGHT OIL PRODUCTS

TABLE 69.—*Producers' price per gallon of pure benzol f. o. b. works and tank-wagon price of gasoline, 1919–1923, by months*

[Prices of benzol are those quoted by Iron Trade Review; of tank-wagon gasoline, average for five cities, computed by J. E. Pogue]

Month	1919		1920		1921		1922		1923	
	Benzol	Gasoline	Benzol	Gasoline	Benzol	Gasoline	Benzol	Gasoline	Benzol	Gasoline
January	$0.245	$0.225	$0.290	$0.231	$0.330	$0.276	$0.290	$0.214	$0.300	$0.193
February	.225	.222	.290	.237	.330	.250	.290	.211	.300	.201
March	.225	.222	.300	.251	.300	.240	.290	.211	.300	.206
April	.215	.222	.310	.259	.300	.236	.290	.217	.300	.199
May	.245	.222	.330	.262	.300	.220	.290	.230	.290	.189
June	.255	.222	.330	.268	.330	.214	.290	.235	.260	.195
July	.260	.222	.380	.268	.330	.206	.300	.236	.260	.194
August	.265	.222	.380	.275	.330	.201	.300	.222	.260	.172
September	.270	.222	.380	.281	.330	.193	.300	.221	.240	.151
October	.270	.222	.380	.281	.330	.201	.300	.213	.220	.142
November	.270	.222	.380	.279	.330	.214	.300	.200	.215	.131
December	.270	.222	.330	.278	.330	.218	.300	.198	.210	.131
Average	.254	.222	.340	.265	.323	.223	.295	.217	.263	.175

TABLE 70.—*Monthly spot prices of coal-tar products in New York market, 1919–1923*

[As quoted by Oil, Paint, and Drug Reporter. Figures are averages of high and low quotations for each month]

Month	Benzol (90 per cent), per gallon					Toluol, per gallon				
	1919	1920	1921	1922	1923	1919	1920	1921	1922	1923
January	$0.245	$0.340	$0.275	$0.270	$0.270	$0.300	$0.280	$0.300	$0.300	$0.300
February	.245	.295	.270	.270	.295	.300	.280	.300	.300	.300
March	.215	.250	.270	.270	.320	.300	.280	.300	.300	.300
April	.225	.265	.270	.270	.320	.300	.280	.300	.300	.300
May	.245	.280	.270	.270	.270	.300	.310	.300	.300	.300
June	.245	.280	.270	.270	.250	.300	.310	.300	.300	.300
July	.253	.325	.270	.270	.250	.300	.345	.300	.300	.300
August	.258	.330	.270	.270	.250	.300	.350	.270	.300	.300
September	.260	.330	.250	.270	.250	.305	.350	.270	.300	.300
October	.290	.325	.250	.270	.210	.295	.350	.270	.300	.260
November	.335	.320	.250	.270	.210	.305	.300	.270	.300	.260
December	.350	.330	.260	.270	.210	.315	.300	.270	.300	.260
Average	.264	.306	.265	.270	.259	.302	.311	.288	.300	.290

Month	Solvent naphtha, per gallon					Naphthalene flakes, per pound				
	1919	1920	1921	1922	1923	1919	1920	1921	1922	1923
January	$0.225	$0.320	$0.280	$0.250	$0.270	$0.105	$0.070	$0.079	$0.065	$0.059
February	.225	.285	.280	.250	.270	.082	.070	.080	.065	.068
March	.225	.220	.280	.250	.270	.077	.081	.077	.062	.085
April	.225	.220	.250	.250	.270	.072	.139	.077	.062	.095
May	.225	.250	.250	.250	.270	.075	.160	.072	.061	.090
June	.225	.250	.250	.270	.270	.075	.170	.075	.062	.086
July	.275	.300	.250	.270	.270	.072	.200	.071	.061	.080
August	.275	.300	.250	.270	.270	.070	.200	.069	.060	.075
September	.275	.300	.250	.270	.270	.070	.152	.066	.060	.069
October	.300	.300	.250	.270	.270	.070	.107	.065	.060	.068
November	.325	.300	.250	.270	.270	.072	.090	.067	.059	.065
December	.335	.280	.250	.270	.270	.072	.081	.067	.057	.060
Average	.261	.277	.258	.262	.270	.076	.127	.072	.061	.075

TABLE 71.—*Production of motor fuel in the United States, 1918–1923, in gallons*

Year	Gasoline production of petroleum refineries [a]	Natural-gas gasoline (total production) [b]	Benzol produced, all grades, including motor benzol		
			Coke ovens	Gas works, including oil and water gas	Tar refineries, etc. [c]
1918	3,570,000,000	283,000,000	44,805,000	[d] 5,633,000	3,015,000
1919	3,958,000,000	352,000,000	61,068,000	(e)	1,826,000
1920	4,883,000,000	385,000,000	72,994,000	[f] 502,000	876,000
1921	5,154,000,000	450,000,000	54,459,000	(e)	2,172,000
1922	6,202,000,000	506,000,000	70,112,000	(g)	[h] 775,000
1923	7,556,000,000	816,000,000	97,335,000	(g)	[h] 395,000

[a] From Bureau of Mines Refinery Statistics for 1923, by W. C. Hill.

[b] From reports of producers to the Geological Survey.

[c] As reported to the U. S. Tariff Commission.

[d] Of this only 2,177,000 gallons was sold, the balance being returned to the gas.

[e] Data not available in comparable form.

[f] Quantity sold, used because of apparent double counting between production figures of crude and refined benzol.

[g] Can not be shown without disclosing individual returns.

[h] Does not include a small amount of motor benzol which can not be shown without disclosing individual returns.

TABLE 72.—*Number of plants making light oil or derivatives, 1922–23*

State	1922				1923			
	Total making coke	Making crude light oil	Making any refined product	Making motor benzol	Total making coke	Making crude light oil	Making any refined product	Making motor benzol
Alabama	7	7	5	5	7	7	5	4
Colorado	1	1	1	1	1	1	1	1
Illinois	6	4	3	3	6	4	3	3
Indiana	6	5	5	5	6	5	5	5
Kentucky	1	1	----------	----------	1	1	----------	----------
Maryland	1	1	1	1	1	1	1	1
Massachusetts	1	----------	----------	----------	1	----------	----------	----------
Michigan	3	2	1	1	3	2	1	1
Minnesota	3	3	2	2	3	2	3	2
Missouri	1	1	1	1	1	1	1	----------
New Jersey	2	----------	----------	----------	2	----------	----------	----------
New York	5	4	3	3	4	4	3	3
Ohio	11	11	8	7	11	11	8	8
Pennsylvania	9	8	7	7	10	9	7	7
Rhode Island	1	----------	----------	----------	1	----------	----------	----------
Tennessee	1	1	1	1	1	1	1	1
Washington	1	----------	----------	----------	1	----------	----------	----------
West Virginia	3	3	2	2	4	4	3	3
Wisconsin	1	1	1	1	1	1	1	----------
	64	53	41	40	65	54	43	39

TABLE 73.—*Benzol produced and sold in the United States in 1923, by States*

State	Produced (gallons)	Sold		
		Gallons	Value	
			Total	Average
Crude benzol:				
Alabama	1,775,710	1,768,092	$185,650	$0.105
Indiana	148,119	146,178	35,730	.244
Minnesota	172	14,387	2,571	.179
New York	1,749,383	1,735,578	390,640	.225
Ohio	463,903	387,929	96,076	.248
Pennsylvania	21,000	----	----	----
West Virginia	164,671	115,508	20,563	.178
Kentucky, Missouri, and Wisconsin	180,470	180,728	37,256	.206
	4,503,428	4,348,400	768,486	.177
Refined benzol:				
Alabama	56,042	55,998	11,223	.200
Colorado	93,464	101,754	25,908	.255
Indiana	560,193	564,713	158,366	.280
Minnesota	175,779	33,600	9,506	.283
New York	3,412,814	3,282,090	832,460	.254
Ohio	3,588,907	3,851,551	948,903	.246
Pennsylvania	2,996,967	3,012,942	740,403	.245
West Virginia	161,034	126,780	28,770	.227
Kentucky, Missouri, and Wisconsin	1,318,843	1,346,354	315,212	.234
	12,364,043	12,375,782	3,070,751	.248
Motor benzol:				
Alabama	9,059,094	9,191,345	1,431,140	.156
Colorado	1,295,367	1,353,920	([a])	([a])
Illinois	4,916,574	4,875,016	773,779	.159
Indiana	12,267,075	11,906,790	1,889,727	.159
Maryland	1,538,588	1,644,831	([a])	([a])
Michigan	1,214,469	1,214,469	331,498	.273
Minnesota	752,792	703,842	144,480	.205
New York	8,780,846	8,757,549	1,423,117	.163
Ohio	13,580,719	13,669,338	2,281,454	.167
Pennsylvania	24,315,545	24,283,963	3,914,453	.161
Tennessee	375,670	395,769	54,357	.145
West Virginia	2,371,144	2,483,494	435,601	.175
Undistributed	----	----	466,227	.155
	80,467,883	80,480,326	13,145,833	.163

[a] Included under "Undistributed."

TABLE 74.—*Toluol and solvent naphtha produced and sold in the United States in 1923, by States*

State	Toluol (crude and refined)[a]				Solvent naphtha			
	Produced (gallons)	Sold			Produced (gallons)	Sold		
		Gallons	Value			Gallons	Value	
			Total	Average			Total	Average
Alabama	20,039	20,039	$3,827	$0.191	646,836	232,854	$38,792	$0.167
Colorado	2,729	2,729	([b])	([b])	231,056	5,006	([b])	([b])
Illinois	19,750	10,133	3,233	.319	32,786	32,084	5,257	.164
Indiana	161,159	151,032	43,549	.288	184,562	271,882	46,105	.170
Maryland	----	----	----	----	35,793	38,984	([b])	([b])
Minnesota	----	----	----	----	2,539	----	----	----
New York	1,234,731	1,155,341	340,523	.295	588,155	559,159	109,320	.196
Ohio	307,785	234,491	64,230	.274	526,153	427,314	103,610	.242
Pennsylvania	734,809	698,615	202,796	.290	1,534,238	1,537,645	248,701	.162
West Virginia	37,989	10,184	2,143	.210	219,581	172,455	29,442	.171
Kentucky, Missouri, and Wisconsin	366,303	352,219	104,813	.293	160,479	122,521	22,707	.185
Undistributed	----	----	916	.336	----	----	4,150	.094
	2,885,294	2,634,783	766,030	.291	4,162,178	3,399,904	608,084	.179

[a] Mainly refined toluol.

[b] Included under "Undistributed."

TABLE 75.—*Crude light oil produced and sold at coke-oven plants in the United States in 1923, by States*

State	Produced (gallons)	Refined on the premises (gallons)	Sold		
			Gallons	Value	
				Total	Average
Alabama	16,615,377	13,940,240			
Colorado	2,097,650	2,092,150			
Illinois	8,670,569	6,297,234	2,239,248	$208,917	$0.093
Indiana	16,651,559	16,645,878			
Maryland	1,335,712	1,934,897			
Michigan	4,005,398	1,367,781			
Minnesota	1,213,538	1,198,738			
New York	7,893,891	20,210,763	304,767	41,023	.135
Ohio	29,160,870	24,119,376	3,677,048	385,216	.105
Pennsylvania	38,397,061	37,370,313	317,526	48,285	.152
Tennessee	453,692	473,225			
West Virginia	5,051,027	4,257,832			
Kentucky, Missouri, and Wisconsin	4,100,831	2,608,962	779	104	.134
	135,647,175	132,517,389	6,539,368	683,545	.105

TABLE 76.—*Crude light oil yields reported by coke-oven plants, 1921–1923*

	1921	1922	1923
Total recovery of crude light oil gallons	76,917,269	101,437,555	135,647,175
Recovery per ton of coal coked:			
At plant reporting minimum average yield do	0.09	0.7	0.8
At plant reporting maximum average yield do	4.0	4.5	4.4
At average plant [a] do	2.7	2.7	2.7
Average recovery for all coal coked [b] do	2.8	2.7	2.7
Total number of plants reporting recovery of light oil	57	53	54
Number of plants recovering—			
Less than 2 gallons per ton of coal	9	9	9
2–2.49 gallons	8	11	12
2.5–2.99 gallons	16	15	12
3–3.49 gallons	10	11	12
3.5–3.99 gallons	12	4	7
4 gallons or more	2	3	2

[a] Sum of averages for all plants divided by number of plants.

[b] Total crude oil recovered divided by number of tons of coal coked at plant recovering the oil.

COKE-OVEN GAS

TABLE 77.—*Disposition of gas from by-product coke ovens, 1915–1923, in per cent*

Year	Wasted	Burned in coking process	Surplus sold or used (not for ovens)	Year	Wasted	Burned in coking process	Surplus sold or used (not for ovens)
1915	3.2	57.3	39.5	1920	2.2	49.5	48.3
1916	4.0	58.4	37.6	1921	2.9	47.4	49.7
1917	5.4	55.7	38.9	1922	1.9	45.9	52.2
1918	4.1	54.8	41.1	1923	2.1	44.9	53.0
1919	2.6	51.0	46.4				

TABLE 78.—*Trend in prices of gas per M cubic feet, 1913–1923*

Year	Average price to householders [a]		Average value of all gas sold [b]		
	Manufactured gas (41 cities)	Natural gas (7 cities)	Natural gas [c]	Coal, oil, and water gas	Coke-oven surplus gas [d]
1913	$0.95	$0.37	$0.151	[e] $0.91	$0.088
1914	.93	.37	.159	([f])	.098
1915	.93	.38	.161	.91	.102
1916	.92	.38	.160	([f])	.098
1917	.91	.38	.179	.87	.087
1918	.95	.43	.213	.91	.087
1919	1.03	.49	.216	([f])	.086
1920	1.08	.49	.246	1.06	.140
1921	1.31	.53	.264	([f])	.168
1922	1.28	.57	.291	1.16	.167
1923	1.26	.58	238	([f])	.162

[a] Computed from statistics of prices published by Bureau of Labor Statistics. See Monthly Labor Review, April, 1924. Average of prices in effect on or near April 15 Further additions to price in form of monthly service charge were made in this period.

[b] As reported by operators to the Geological Survey.

[c] Average value of all natural gas at point of consumption.

[d] Includes value of gas used by producer (not for ovens).

[e] Represents 1912.

[f] No report.

TABLE 79.—*Total production of gas fuel in the United States, 1913–1923*

[Does not include producer gas, blast-furnace gas, Pintsch gas, or acetylene]

Year	Quantity sold (billion cubic feet)				Rough equivalent in heating value (billion British thermal units)			
	1 Surplus coke-oven gas	2 Coal, oil, and water gas	3 Natural gas	4 Total	5 Surplus coke-oven gas (1×550)	6 Coal oil, and water gas (2×575)	7 Natural gas (3×1,000)	8 Total (5+6+7)
Quantity								
1913	64	[a] 166	582	812	35,200	95,450	582,000	712,650
1914	61	174	592	827	33,550	100,050	592,000	725,600
1915	84	[a] 182	629	895	46,200	104,650	629,000	779,850
1916	110	196	753	1,059	60,500	112,700	753,000	926,200
1917	131	[a] 211	795	1,137	72,050	121,325	795,000	988,375
1918	158	234	721	1,113	86,900	134,550	721,000	942,450
1919	193	[a] 248	746	1,187	106,150	142,600	746,000	994,750
1920	230	262	798	1,290	126,500	150,650	798,000	1,075,150
1921	154	[b] 246	662	1,062	84,700	141,450	662,000	888,150
1922	231	257	763	1,251	127,050	147,775	763,000	1,037,825
1923	318	[c] 260	1,008	1,586	174,900	149,500	1,008,000	1,332,400
Per cent								
1913	7.9	20.5	71.6	100.0	4.9	13.4	81.7	100.0
1914	7.4	21.0	71.6	100.0	4.6	13.8	81.6	100.0
1915	9.4	20.3	70.3	100.0	5.9	13.4	80.7	100.0
1916	10.4	18.5	71.1	100.0	6.5	12.2	81.3	100.0
1917	11.5	18.6	69.9	100.0	7.3	12.3	80.4	100.0
1918	14.2	21.0	64.8	100.0	9.2	14.3	76.5	100.0
1919	16.3	20.9	62.8	100.0	10.7	14.3	75.0	100.0
1920	17.8	20.3	61.9	100.0	11.8	14.0	74.2	100.0
1921	14.5	23.2	62.3	100.0	9.6	15.9	74.5	100.0
1922	18.5	20.5	61.0	100.0	12.3	14.2	73.5	100.0
1923	20.1	16.4	63.5	100.0	13.1	11.2	75.7	100.0

[a] Estimated by assuming a uniform rate of increase between successive years reported.

[b] Estimated from census reports, which show slight decrease as compared with 1919, although the census returns include some coke ovens.

[c] Estimated.

TABLE 80.—*Coke-oven gas produced and sold in the United States in 1923, by States*

State	Number of plants	Produced (M cubic feet)	Used in process (M cubic feet)	Sold or used			Wasted (M cubic feet)
				M cubic feet	Value		
					Total	Average	
Alabama	7	73, 277, 080	35, 230, 277	34, 500, 477	$2, 752, 798	$0. 080	3, 546, 326
Colorado	1	7, 335, 238	2, 958, 500	4, 350, 488	(a)	(a)	26, 250
Illinois	6	51, 337, 897	18, 284, 390	32, 557, 155	6, 054, 425	. 186	496, 352
Indiana	6	79, 368, 387	38, 375, 158	39, 095, 909	7, 733, 371	. 198	1, 897, 320
Maryland	1	12, 738, 452	3, 760, 750	8, 977, 702	(a)	(a)	----------
Massachusetts	1	7, 967, 132	4, 183, 684	3, 783, 448	(a)	(a)	----------
Michigan	3	24, 288, 720	12, 902, 371	11, 386, 349	3, 716, 747	. 326	----------
Minnesota	3	10, 644, 602	5, 312, 213	5, 072, 725	1, 422, 221	. 280	259, 664
New Jersey	2	13, 810, 968	2, 477, 132	11, 333, 836	(a)	(a)	----------
New York	4	28, 731, 651	15, 730, 237	12, 932, 680	1, 970, 810	. 150	68, 734
Ohio	11	105, 692, 302	46, 680, 814	56, 414, 825	6, 460, 667	. 115	2, 596, 663
Pennsylvania	10	146, 208, 327	65, 654, 370	78, 213, 805	8, 766, 670	. 111	2, 340, 152
Tennessee	1	1, 623, 419	726, 757	896, 662	164, 729	. 183	----------
Washington	1	523, 692	----------	490, 752	637, 667	1. 299	32, 940
West Virginia	4	15, 152, 192	7, 121, 766	6, 912, 316	1, 134, 107	. 164	1, 118, 110
Kentucky, Missouri, Rhode Island, and Wisconsin	4	22, 455, 234	10, 769, 709	11, 523, 125	3, 475, 937	. 302	162, 400
Undistributed	------	----------	----------	----------	7, 319, 071	. 257	----------
	65	601, 155, 293	270, 168, 128	318, 442, 254	51, 609, 220	. 162	12, 544, 911

[a] Included under "Undistributed."

TABLE 81.—*Disposition of gas from by-product ovens in the United States, 1921–1923*

	Millions of cubic feet	Percentage of total production	Value	
			Total	Cents per M
1921				
Used under boilers	12, 123	3. 9	$1, 120, 087	9. 2
Used in steel or other related plants	98, 352	31. 7	10, 593, 204	10. 8
Distributed through city mains (sold), including sales to nonaffiliated industries	43, 826	14. 1	14, 249, 961	32. 5
Total sold or used (not for ovens)	154, 301	49. 7	25, 963, 252	16. 8
Used in heating ovens	147, 038	47. 4	----------	--------
Wasted	8, 850	2. 9	----------	--------
Total produced	310, 189	100. 0	----------	--------
1922				
Used under boilers	19, 124	4. 3	1, 251, 325	6. 5
Used in steel or other related plants	144, 976	32. 7	15, 942, 446	11. 0
Distributed through city mains	56, 930	12. 9	20, 326, 648	35. 7
Sold for industrial purposes	10, 353	2. 3	1, 104, 901	10. 7
Total sold or used (not for ovens)	231, 383	52. 2	38, 625, 320	16. 7
Used in heating ovens	203, 239	45. 9	----------	--------
Wasted	8, 049	1. 9	----------	--------
Total produced	442, 671	100. 0	----------	--------
1923				
Used under boilers	33, 741	5. 6	1, 820, 808	5. 4
Used in steel or other related plants	200, 099	33. 3	22, 646, 134	11. 3
Distributed through city mains	65, 143	10. 8	23, 116, 578	35. 5
Sold for industrial purposes	19, 459	3. 3	4, 025, 700	20. 7
Total sold or used (not for ovens)	318, 442	53. 0	51, 609, 220	16. 2
Used in heating ovens	270, 168	44. 9	----------	--------
Wasted	12, 545	2. 1	----------	--------
Total produced	601, 155	100. 0	----------	--------

TABLE 82.—*Use of by-product gas in the United States, 1922–23, by States*

State	Used under boilers			Used in steel or other affiliated plants			Distributed through city mains			Sold for industrial purposes		
	M cubic feet	Value		M cubic feet	Value		M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
1922												
Alabama	8, 130, 841	$425, 258	$0. 052	13, 935, 292	$798, 597	$0. 057	1, 184, 175	$178, 060	$0. 150	2, 288, 649	$198, 541	$0. 087
Colorado				3, 145, 778	(a)	(a)						
Illinois	215, 257	22, 992	. 107	3, 857, 323	462, 879	. 120	10, 828, 629	3, 871, 303	. 357	687, 459	135, 670	. 197
Indiana	816, 904	93, 327	. 114	24, 991, 497	2, 842, 949	. 114	3, 731, 827	1, 775, 975	. 476	535, 950	183, 114	. 342
Maryland				1, 724, 249	(a)	(a)	4, 428, 076	(a)	(a)	138, 708	19, 234	. 138
Massachusetts							2, 741, 614	(a)	(a)			
Michigan	120	6	. 050	2, 919, 607	888, 009	. 304	6, 812, 725	2, 327, 248	. 342	16, 095	805	. 050
Minnesota	278, 534	16, 355	. 059	287, 938	40, 311	. 140	2, 808, 116	1, 003, 210	. 357			
New Jersey							10, 995, 178	(a)	(a)			
New York	2, 879, 929	231, 732	. 080	6, 177, 733	408, 782	. 066	2, 092, 952	1, 050, 705	. 502	168	87	. 518
Ohio	1, 936, 547	177, 409	. 089	32, 541, 577	4, 044, 058	. 124	793, 156	75, 364	. 095	5, 486, 661	497, 500	. 091
Pennsylvania	1, 899, 201	170, 825	. 090	53, 104, 940	5, 756, 618	. 108	1, 733, 117	294, 947	. 170	543, 640	42, 611	. 078
Tennessee	109, 970	3, 849	. 035				69, 491	22, 112	. 318			
Washington	2, 637	2, 264	. 859				81, 900	57, 119	. 697			
West Virginia	284, 399	6, 929	. 024	2, 290, 096	166, 572	. 073	2, 100, 000	462, 000	. 220			
Kentucky, Missouri, Rhode Island, and Wisconsin	2, 509, 475	100, 379	. 040				6, 529, 297	2, 723, 256	. 417	655, 591	27, 339	. 042
Undistributed					533, 671	. 110		6, 485, 349	. 357			
	19, 123, 814	1, 251, 325	. 065	144, 976, 030	15, 912, 446	. 110	56, 930, 253	20, 326, 648	. 357	10, 352, 921	1, 104, 901	. 107

[a] Included under "Undistributed."

TABLE 82.—*Use of by-product gas in the United States, 1922–23, by States*—Continued

State	Used under boilers			Used in steel or other affiliated plants			Distributed through city mains			Sold for industrial purposes		
	M cubic feet	Value		M cubic feet	Value		M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
1923												
Alabama	11, 840, 554	$613, 761	$0. 052	18, 157, 713	$1, 170, 254	$0. 064	1, 436, 320	$219, 047	$0. 153	3, 065, 890	$749, 736	$0. 245
Colorado				4, 350, 488	(a)	(a)						
Illinois	8, 424, 498	186, 299	. 022	8, 716, 990	1, 115, 567	. 128	13, 938, 775	4, 460, 324	. 320	1, 476, 892	292, 235	. 198
Indiana	1, 585, 969	141, 451	. 089	31, 534, 381	4, 303, 929	. 136	4, 733, 404	2, 862, 427	. 604	1, 242, 155	425, 564	. 343
Maryland				3, 564, 271	(a)	(a)	5, 413, 431	(a)	(a)			
Massachusetts							3, 783, 448	(a)	(a)			
Michigan	120	4	. 033	3, 772, 437	1, 131, 731	. 300	7, 592, 762	2, 579, 481	. 340	21, 030	5, 531	. 263
Minnesota	235, 510	20, 104	. 085	1, 633, 105	209, 605	. 128	3, 204, 110	1, 192, 512	. 372			
New Jersey							11, 333, 836	(a)	(a)			
New York	1, 162, 006	58, 190	. 050	9, 714, 394	638, 949	. 128	1, 033, 303	381, 289	. 369	1, 022, 977	892, 382	. 872
Ohio	5, 297, 645	523, 859	. 099	42, 445, 912	5, 171, 885	. 122				8, 671, 268	764, 923	. 088
Pennsylvania	2, 217, 941	161, 769	. 073	72, 652, 785	7, 817, 586	. 108	3, 143, 088	765, 993	. 244	199, 991	21, 322	. 107
Tennessee	410, 560	14, 370	. 035				486, 102	150, 359	. 309			
Washington	4, 872	4, 039	. 829				485, 880	633, 628	1. 304			
West Virginia	207, 454	12, 217	. 059	3, 556, 724	273, 435	. 077				3, 148, 138	848, 455	. 270
Kentucky, Missouri, Rhode Island, and Wisconsin	2, 353, 629	84, 745	. 036				8, 559, 056	3, 365, 640	. 393	610, 440	25, 552	. 042
Undistributed					813, 193	. 103		6, 505, 878	. 317			
	33, 740, 758	1, 820, 808	. 054	200, 099, 200	22, 646, 134	. 113	65, 143, 515	23, 116, 578	. 355	19, 458, 781	4, 025, 700	. 207

[a] Included under "Undistributed."

TABLE 83.—*Yield and disposal of gas and number of plants supplying gas for certain uses, 1922–23, by States*

State	Yield of gas (M cubic feet) per ton of coal coked	Disposal (per cent of total)						Number of plants	
		In coke plants		To steel or other affiliated plants	For distribution through city mains	For industrial purposes	Wasted	Supplying gas for city distribution	Supplying gas to steel or other affiliated plants
		For use in heating coke ovens	For use under boilers						
1922									
Alabama	11.1	49.6	14.3	24.6	2.1	4.0	5.4	2	4
Colorado	11.2	45.1	--------	53.1	--------	--------	1.8	--------	1
Illinois	11.1	50.7	.7	12.1	33.9	2.1	.5	5	1
Indiana	11.2	49.3	1.3	40.4	6.0	.9	2.1	5	3
Kentucky	11.3	52.7	35.4	--------	--------	9.3	2.6	--------	--------
Maryland	11.5	31.5	--------	18.8	48.2	1.5	--------	1	1
Massachusetts	10.0	54.8	--------	--------	45.2	--------	--------	1	--------
Michigan	11.0	43.7	--------	16.9	39.4	--------	--------	3	1
Minnesota	10.1	51.2	4.0	4.1	40.4	--------	.3	2	1
New Jersey	11.4	11.0	--------	--------	89.0	--------	--------	2	--------
New York	10.7	52.8	12.1	26.0	8.8	--------	.3	2	2
Ohio	10.8	44.7	2.6	42.5	1.0	7.2	2.0	3	7
Pennsylvania	10.2	44.9	1.8	50.3	1.6	.5	.9	2	8
Tennessee	9.7	50.0	30.6	--------	19.4	--------	--------	1	--------
Washington	9.6	--------	2.9	--------	90.9	--------	6.2	1	--------
West Virginia	11.3	38.6	3.3	26.8	24.6	--------	6.7	1	1
Missouri, Rhode Island, and Wisconsin	10.9	45.9	--------	--------	53.0	--------	1.1	3	--------
	10.8	45.9	4.3	32.7	12.9	2.3	1.9	34	30
1923									
Alabama	11.4	48.1	16.2	24.8	1.9	4.2	4.8	2	4
Colorado	11.2	40.4	--------	59.3	--------	--------	.3	--------	1
Illinois	11.2	35.6	16.4	16.9	27.2	2.9	1.0	4	2
Indiana	11.1	48.3	2.0	39.7	6.0	1.6	2.4	5	3
Maryland	10.9	29.5	--------	28.0	42.5	--------	--------	1	1
Massachusetts	10.0	52.5	--------	--------	47.5	--------	--------	1	--------
Michigan	10.6	53.1	--------	15.6	31.2	.1	--------	3	1
Minnesota	10.6	49.9	2.2	15.3	30.2	--------	2.4	2	1
New Jersey	11.4	18.0	--------	--------	82.0	--------	--------	2	--------
New York	11.0	54.7	4.0	33.8	3.6	3.6	.3	1	2
Ohio	11.4	44.2	5.0	40.2	--------	8.2	2.4	--------	8
Pennsylvania	10.9	44.9	1.5	49.7	2.2	.1	1.6	4	8
Tennessee	9.5	44.7	25.4	--------	29.9	--------	--------	1	--------
Washington	9.6	--------	.9	--------	92.8	--------	6.3	1	--------
West Virginia	10.8	47.0	1.3	23.5	--------	20.8	7.4	--------	2
Kentucky, Missouri, Rhode Island, and Wisconsin	10.8	48.0	10.5	--------	38.1	2.7	.7	3	--------
	11.1	44.9	5.6	33.3	10.8	3.3	2.1	30	33

TABLE 84.—*Gas used in heating ovens, 1921–1923*

	1921	1922	1923
Total quantity of gas reported as used in heating ovens M cubic feet	147, 037, 412	203, 238, 843	270, 168, 128
Percentage of total production used:			
At plant reporting minimum percentage	[a] 14. 5	[a] 13. 6	22. 4
At plant reporting maximum percentage	93. 6	97. 7	84. 3
At average plant [b]	53. 7	49. 7	48. 3
Average for all gas produced [c]	47. 4	45. 9	44. 9
Total number of plants reporting	63	59	61
Number of plants reporting—			
Less than 20 per cent used	[a] 1	[a] 1	1
20–29.9 per cent	[d] 2		2
30–39.9 per cent	8	8	13
40–44.9 per cent	13	14	10
45–49.9 per cent	11	15	11
50–59.9 per cent	9	10	11
60–69.9 per cent	9	7	10
70–79. 9 per cent	2	2	2
80–89.9 per cent	2	1	1
90 per cent or more	6	1	

[a] This plant used also some other gas for heating ovens.
[b] Sum of averages for all plants divided by number of plants.
[c] Total gas used in heating all ovens divided by total gas produced.
[d] Probably does not represent the total used.

TABLE 85.—*Yield of gas per ton of coal coked reported by coke plants, 1921–1923*

	1921	1922	1923
Total production of gas M cubic feet	310, 188, 713	442, 671, 114	601, 155, 293
Yield of gas per ton of coal coked:			
At plant reporting minimum average yield do	5. 0	7. 5	7. 2
At plant reporting maximum average yield do	14. 1	12. 8	15. 9
At average plant [a] do	10. 5	10. 7	10. 9
Average for all coal coked [b] do	10. 8	10. 8	11. 1
Total number of plants reporting recovery of gas	67	63	65
Number of plants reporting yields of—			
Less than 8 M cubic feet per ton of coal coked	2	1	1
8–8.99 M cubic feet	3	2	1
9–9.99 M cubic feet	12	10	8
10–10.49 M cubic feet	11	18	10
10.5–10.99 M cubic feet	21	6	17
11–11.99 M cubic feet	10	19	17
12 M cubic feet or more	8	7	11

[a] Sum of averages for all plants divided by number of plants.
[b] Total production of gas divided by number of tons of coal coked.

NAPHTHALENE

TABLE 86.—*Total commercial production of naphthalene from all sources in the United States, 1918–1923*

[Total sales are shown for coke plants and gas works to avoid double counting in production of crude and refined]

	By-product coke ovens; sales of crude and refined	City gas works; sales of crude and refined	Tar distilleries and all other establishments	Total commercial production
Quantity (pounds):				
1918	15,890,447	896,080	40,138,092	56,924,619
1919	6,702,040	(a)	12,612,203	20,114,243
1920	14,448,762	1,760,293	26,393,411	42,602,466
1921	1,983,523	(a)	16,949,464	19,432,987
1922	4,887,935	(a)	19,323,393	25,411,328
1923	11,245,633	1,452,463	41,453,002	54,151,098
Value:				
1918	$650,229	$14,282	$1,281,440	$1,945,951
1919	191,364	(a)	327,201	542,565
1920	487,974	63,449	791,403	1,342,826
1921	59,335	(a)	380,167	462,502
1922	131,252	(a)	352,957	536,209
1923	239,699	45,981	652,148	937,828

	Imports of crude (free) [b]	Imports of refined (dutiable) [b]	Total imports [b]	Total produced and imported	Average spot price of flake in New York (cents per pound)
Quantity (pounds):					
1918	3,902,731	2,795	3,905,526	60,830,145	------------
1919	3,239,256	7,650	3,246,906	23,361,149	------------
1920	15,012,096	3,697,562	18,709,658	61,312,124	------------
1921	4,495,806	441,685	4,937,491	24,370,478	------------
1922	3,144,332	75,680	3,220,012	28,631,340	------------
1923	20,992,439	9,605	21,002,044	75,153,142	------------
Value:					
1918	$130,098	$171	$130,269	$2,076,220	9.95
1919	92,265	384	92,649	635,214	7.63
1920	530,219	416,172	946,391	2,289,217	12.68
1921	135,943	31,458	167,401	629,903	7.23
1922	54,029	7,684	61,713	597,922	6.15
1923	575,702	194	575,896	1,513,724	7.49

[a] Data lacking or incomplete. Estimate included in total.
[b] Imports entered for consumption as reported by Tariff Commission.

TABLE 87.—*Naphthalene sold by by-product coke operators, 1916–1923*

Year	Quantity (pounds)			Value	Average receipts per pound (cents)		Receipts per ton of coke (cents)
	Crude	Refined	Total		Crude	Refined	
1916	(a)	(a)	8,820,405	$289,688	3.4		1.5
1917	(a)	(a)	17,276,044	569,449	3.3		2.5
1918	10,403,758	5,486,689	15,890,447	650,229	2.8	6.6	2.5
1919	4,038,455	2,663,585	6,702,040	191,364	2.0	4.1	.8
1920	11,507,703	2,941,059	14,448,762	487,974	2.7	6.1	1.6
1921	1,652,466	331,057	1,983,523	59,335	2.5	5.6	.3
1922	3,298,851	1,589,084	4,887,935	131,252	1.6	5.0	.5
1923	10,047,427	1,198,206	11,245,633	239,699	1.7	5.5	.6

[a] Not separately reported.

PRODUCTION BY STATES

TABLE 88.—*Coke produced in the United States, 1880–1923, in net tons*

Year	Alabama	Colorado	Georgia	Illinois	Indiana	Kansas	Kentucky	Maryland	Massachusetts	Michigan	Minnesota	Missouri	Montana	New Jersey	New Mexico
1880	60,781	25,568	38,041	12,700	---	3,070	4,250	---	---	---	---	---	---	---	---
1881	109,033	48,587	41,376	14,800	---	5,670	4,370	---	---	---	---	---	---	---	---
1882	152,940	102,105	46,602	11,400	---	6,080	4,070	---	---	---	---	---	---	---	1,000
1883	217,531	133,997	67,012	13,400	---	8,430	5,025	---	---	---	---	---	---	---	3,905
1884	244,009	115,719	79,268	13,095	---	7,190	2,223	---	---	---	---	---	75	---	18,282
1885	301,180	131,960	70,669	10,350	---	8,050	2,704	---	---	---	---	---	175	---	17,940
1886	375,054	142,797	82,680	8,103	6,124	12,493	4,528	---	---	---	---	---	---	---	10,236
1887	325,020	170,698	79,241	9,198	17,658	14,950	14,565	---	---	---	---	2,970	7,200	---	13,710
1888	508,511	179,682	83,721	7,410	11,956	14,831	23,150	---	---	---	---	2,600	12,000	---	8,540
1889	1,030,510	187,638	94,727	11,583	8,301	13,910	13,021	---	---	---	---	5,275	14,043	---	3,460
1890	1,072,942	245,756	102,233	5,000	6,013	12,311	12,343	---	---	---	---	6,136	14,427	---	2,050
1891	1,282,496	277,074	103,057	5,200	3,798	14,174	33,777	---	---	---	---	6,872	29,009	---	2,300
1892	1,501,571	[a] 373,229	81,807	3,170	3,207	9,132	36,123	---	---	---	---	7,299	34,557	---	---
1893	1,168,085	[a] 362,986	90,726	2,200	5,724	8,565	48,619	---	---	---	---	5,905	29,945	---	5,803
1894	923,817	[a] 317,196	93,029	2,200	6,551	8,439	29,748	---	---	---	---	2,250	17,388	---	6,529
1895	1,444,339	[a] 340,357	60,212	2,250	4,804	5,287	25,460	---	---	---	---	2,028	25,337	---	14,663
1896	1,479,437	[a] 363,760	53,673	2,600	4,353	4,785	27,107	---	---	---	---	2,500	60,078	---	24,228
1897	1,443,017	[a] 342,653	33,000	1,549	2,904	6,181	32,117	---	---	---	---	2,593	67,849	---	1,438
1898	1,663,020	[a] 474,808	49,529	2,325	1,825	4,180	22,242	---	---	---	---	740	52,009	---	6,980
1899	1,787,809	[a] 530,424	50,907	[b] 2,370	(b)	14,476	81,095	---	(c)	---	---	2,860	56,376	---	44,134
1900	2,110,837	[a] 618,755	73,928	(d)	(d)	5,948	95,532	---	(d)	(d)	---	2,087	54,731	---	44,774
1901	2,148,911	[a] 671,303	54,550	(d)	(d)	7,138	100,285	---	(d)	(d)	---	4,749	57,004	---	41,643
1902	2,552,246	[a] 1,003,393	82,064	(d)	(d)	20,902	126,879	---	(d)	(d)	---	5,780	53,463	---	23,296
1903	2,693,497	[a] 1,053,840	85,546	(d)	(d)	14,194	115,362	(d)	(d)	(d)	---	1,839	45,107	(d)	11,050
1904	2,340,219	[a] 789,0[illegible]0	75,812	4,439	(d)	9,460	64,112	(d)	(d)	(d)	(d)	2,446	41,497	(d)	58,259
1905	2,576,986	[a] 1,378,824	70,593	10,307	---	4,425	79,487	(d)	(d)	(d)	(d)	1,580	31,482	(d)	89,638
1906	3,034,501	[a] 1,455,905	70,280	268,693	---	1,698	74,064	(d)	(d)	(d)	(d)	---	38,182	(d)	147,747
1907	3,021,794	[a] 1,421,579	74,934	372,697	---	6,274	67,068	332,253	466,458	(d)	(d)	---	40,714	256,057	265,125
1908	2,362,666	[a] 982,291	39,422	362,182	(d)	2,497	37,827	270,916	453,883	(d)	(d)	---	(d)	248,893	274,565
1909	3,035,824	[a] 1,251,805	46,385	1,276,956	(d)	---	46,371	315,587	444,349	(d)	(d)	---	(d)	261,460	373,967
1910	3,249,027	[a] 1,346,211	43,814	1,514,504	(d)	(d)	53,857	335,373	450,001	(d)	(d)	---	(d)	250,153	401,646
1911	2,761,521	[a] 1,177,023	37,553	1,610,212	(d)	(d)	66,099	343,451	477,564	(d)	(d)	---	(d)	255,334	381,927
1912	2,975,489	972,941	43,158	1,764,944	2,616,339	(d)	191,555	304,715	511,596	(d)	(d)	---	---	304,715	413,906
1913	3,323,664	879,461	42,747	1,859,553	2,727,025	---	317,084	236,423	531,384	(d)	(d)	---	---	255,792	467,945
1914	3,084,149	666,083	24,517	1,425,168	2,276,652	---	443,959	87,852	540,631	(d)	(d)	---	---	255,283	362,572
1915	3,071,811	670,938	20,039	1,686,998	2,768,099	---	526,097	313,283	504,438	(d)	127,847	(d)	---	269,448	389,411
1916	4,298,417	1,053,553	47,127	2,320,400	3,489,660	---	802,526	489,982	563,048	(d)	431,319	(d)	---	210,766	502,812
1917	4,892,589	1,112,449	39,589	2,289,833	3,540,718	---	863,071	518,810	595,113	(d)	490,272	(d)	---	423,361	577,679
1918	4,352,172	989,447	22,048	2,285,610	3,898,215	---	818,785	474,368	556,397	(d)	784,065	(d)	---	682,148	597,072
1919	3,380,771	613,753	18,149	1,703,903	3,702,180	---	691,969	356,237	393,331	808,729	586,094	(d)	---	788,465	260,162
1920	4,013,891	789,499	16,523	2,136,793	4,553,697	---	739,577	682,132	488,089	1,393,445	674,801	(d)	---	725,571	(d)
1921	2,534,039	368,131	6,943	1,322,178	3,091,263	---	284,825	292,439	294,059	777,125	435,866	(d)	---	739,768	(d)
1922	3,799,865	484,039	8,832	1,982,906	3,995,505	---	487,167	589,893	407,081	1,142,059	462,044	(d)	---	790,811	87,631
1923	4,654,075	647,823	12,556	3,187,168	5,042,614	---	559,711	861,668	554,125	1,648,773	695,824	(d)	---	897,569	(d)

Year	New York	Ohio	Oklahoma (Indian Territory)	Pennsylvania	Rhode Island	Tennessee	Texas	Utah	Virginia	Washington	West Virginia	Wisconsin	Wyoming	Combined States	Total
1880	--------	100,596	1,546	2,821,384	--------	130,609	--------	1,000	--------	--------	138,755	--------	--------	--------	3,338,300
1881	--------	119,469	1,768	3,437,708	--------	143,853	--------	--------	--------	--------	187,126	--------	--------	--------	4,113,760
1882	--------	103,722	2,025	3,945,034	--------	187,695	--------	250	--------	--------	230,398	--------	--------	--------	4,793,321
1883	--------	87,834	2,573	4,438,464	--------	203,691	--------	--------	25,340	--------	257,519	--------	--------	--------	5,464,721
1884	--------	62,709	1,912	3,822,128	--------	219,723	--------	--------	63,600	400	223,472	--------	--------	--------	4,873,805
1885	--------	39,416	3,584	3,991,805	--------	218,842	--------	--------	49,139	311	260,571	--------	--------	--------	5,106,696
1886	--------	34,932	6,351	5,406,597	--------	368,139	--------	--------	122,352	825	264,158	--------	--------	--------	6,845,369
1887	--------	93,004	10,060	5,832,849	--------	396,979	--------	--------	166,947	14,625	442,031	--------	--------	--------	7,611,705
1888	--------	67,194	7,502	6,545,779	--------	385,693	--------	--------	149,199	--------	531,762	500	--------	--------	8,540,030
1889	--------	75,124	6,639	7,659,055	--------	359,710	--------	761	146,528	3,841	607,880	16,016	--------	--------	10,258,022
1890	--------	74,633	6,639	8,560,245	--------	348,728	--------	8,528	165,847	5,837	833,377	24,976	--------	--------	11,508,021
1891	--------	38,718	9,464	6,954,846	--------	364,318	--------	7,949	167,516	6,000	1,009,051	34,387	2,682	--------	10,352,688
1892	--------	51,818	3,569	8,327,612	--------	354,096	--------	(a)	147,912	7,177	1,034,750	33,800	--------	--------	12,010,829
1893	12,850	22,436	7,135	6,229,051	--------	265,777	--------	(a)	125,092	6,731	1,062,076	14,958	2,916	--------	9,477,580
1894	16,500	32,640	3,051	6,063,777	--------	292,646	--------	(a)	180,091	5,245	1,193,933	4,250	4,352	--------	9,203,632
1895	18,521	29,050	5,175	9,404,215	--------	395,790	286	(a)	244,738	15,129	1,285,206	4,972	4,895	--------	13,333,714
1896	(c)	80,868	21,021	[e] 7,356,502	--------	339,202	--------	(a)	268,081	25,949	1,649,755	5,332	19,542	--------	11,788,773
1897	(c)	95,087	30,364	[e] 8,966,924	--------	368,769	394	(a)	354,067	26,189	1,472,666	17,216	24,007	--------	13,288,984
1898	(c)	85,535	34,110	[e] 10,715,302	--------	394,545	--------	(a)	531,161	30,197	1,925,071	35,280	18,350	--------	16,047,209
1899	(c)	83,878	24,339	[f] 13,577,870	--------	435,308	--------	(a)	618,707	30,372	2,278,577	33,437	15,630	--------	19,668,569
1900	(d)	72,116	38,141	13,357,295	--------	475,432	--------	(a)	685,156	33,387	2,358,499	(d)	(d)	506,730	20,533,348
1901	(d)	108,774	37,374	14,355,917	--------	404,017	--------	(a)	907,130	49,197	2,283,700	(d)	(d)	564,191	21,795,883
1902	(d)	146,099	49,441	16,497,910	--------	560,006	--------	(a)	1,124,572	40,305	2,516,505	(d)	(d)	598,869	25,401,730
1903	(d)	143,913	49,818	15,650,932	--------	546,875	--------	(a)	1,176,439	45,623	2,707,818	(d)	(d)	932,428	25,274,281
1904	(d)	109,284	44,808	14,861,064	--------	379,240	--------	(a)	1,101,716	45,432	2,283,086	(d)	(d)	1,451,172	23,661,106
1905	(d)	277,130	54,781	20,573,736	--------	468,092	--------	(a)	1,499,481	53,137	3,400,593	(d)	(d)	1,660,857	32,231,129
1906	(d)	293,994	49,782	23,060,511	--------	483,428	--------	(a)	1,577,659	45,642	3,713,514	(d)	(d)	2,085,617	36,401,217
1907	385,478	270,634	19,089	26,513,214	--------	467,499	--------	(a)	1,545,280	52,028	4,112,896	(d)	--------	1,088,493	40,779,564
1908	473,569	159,578	2,944	15,511,634	--------	214,528	--------	(a)	1,162,051	38,889	2,637,123	(d)	--------	798,060	26,033,518
1909	523,551	222,711	(d)	24,905,525	--------	261,808	--------	(a)	1,347,478	42,981	3,943,948	(d)	--------	964,359	39,315,065
1910	652,459	282,315	(d)	26,315,607	--------	322,756	--------	(a)	1,493,655	59,337	3,803,850	(d)	--------	1,134,245	41,708,810
1911	686,172	311,382	--------	21,923,935	--------	330,418	--------	(a)	910,411	40,180	2,291,049	(d)	--------	1,947,258	35,551,489
1912	794,618	388,669	--------	27,438,093	--------	370,076	--------	(d)	967,947	49,260	2,465,986	(d)	--------	1,408,992	43,983,599
1913	758,486	351,846	--------	28,753,444	--------	364,578	--------	(d)	1,303,603	76,221	2,472,752	(d)	--------	1,577,522	46,299,530
1914	457,370	521,638	--------	20,258,393	--------	264,127	--------	(d)	780,984	84,923	1,427,962	(d)	--------	1,593,651	34,555,914
1915	684,461	684,658	--------	25,622,862	--------	256,973	--------	(d)	629,807	136,552	1,391,446	(d)	--------	1,825,982	41,581,150
1916	775,014	1,803,268	--------	31,279,695	--------	382,175	--------	(g)	1,242,332	[g] 534,653	2,521,309	(d)	--------	1,785,529	54,533,585
1917	993,184	3,694,302	--------	27,912,025	--------	411,326	--------	(g)	1,304,230	[g] 497,533	3,349,761	(d)	--------	2,100,983	55,606,828
1918	1,069,587	5,365,243	(d)	26,723,645	--------	427,106	--------	(d)	1,234,256	123,788	3,320,006	(d)	--------	2,754,414	56,478,372
1919	751,067	5,481,660	(d)	20,501,831	(d)	260,915	--------	(d)	930,516	62,546	1,413,932	(d)	--------	1,474,347	44,180,557
1920	1,040,192	5,701,810	--------	23,638,739	(d)	301,708	--------	(d)	1,027,788	59,395	1,828,336	(d)	--------	1,533,057	51,345,043
1921	746,916	3,028,423	--------	9,769,476	(d)	85,728	--------	(d)	280,476	27,260	397,892	(d)	--------	804,815	25,287,622
1922	1,494,992	5,011,138	--------	13,991,892	(d)	113,896	--------	172,453	378,656	31,674	919,744	(d)	--------	771,734	37,124,012
1923	1,783,948	6,473,606	(d)	25,624,286	(d)	304,511	--------	232,941	774,887	69,068	1,762,775	(d)	--------	1,189,606	56,977,534

[a] Utah included with Colorado.
[b] Indiana included with Illinois.
[c] Included with Pennsylvania.
[d] Included under "Combined States."
[e] Includes New York.
[f] Includes Massachusetts and New York.
[g] Utah included with Washington.

COAL

By F. G. Tryon and L. Mann

INTRODUCTION

SPECIAL WORK BY COAL UNIT OF GEOLOGICAL SURVEY

With the publication of this report the continuous statistical record of coal production maintained by the United States Geological Survey reaches its forty-second year. The 1923 report, like its immediate predecessors, has been delayed by the pressure of other duties laid upon the Survey staff engaged in this work. Since the issue of the 1922 coal report the energies of the staff have been largely devoted to correcting and editing the report of the United States Coal Commission, the five volumes of which have recently appeared. The senior author of this chapter had been statistical adviser to the commission, and from January to July, 1925, the editing of the commission's studies absorbed most of his time. Further, the necessary proof reading made serious inroads on the regular work of his assistants. The sacrifice of the Survey's immediate interest was felt to be in the larger interest of the public and the coal industry. Opinions will differ as to the wisdom of the coal commission's recommendations, with which the authors of this chapter are not concerned, but there will be little dispute that the statistical studies of the commission form the most comprehensive source of data concerning the industry so far published. The fact that the Government had spent nearly $600,000 and the industry probably a much greater sum in preparing and tabulating the statistical schedules justified the greatest care in checking and correcting the tables and in so annotating and indexing them as to make the mass of material reasonably accessible.

For these reasons the present report appears many months late. In the meantime, however, the need of prompt publication of the fundamental figures has been met by releasing them as soon as completed in the Geological Survey's weekly coal report. In this way the principal statistics were made public in mimeographed form between September 1 and December 31, 1924.

ACKNOWLEDGMENTS

This report is based on the voluntary cooperation of those engaged in the coal industry, and it is a pleasure to acknowledge the courteous help of the thousands of individual producers, railroad officials, and consumers who have supplied information. Special mention should be made of the assistance of the secretaries of local coal operators' associations and the traffic managers of the principal coal railroads, who have not only assisted in collecting facts but have contributed much essential information through their familiarity with local conditions. The State geologists of Alabama, Illinois, Iowa, Georgia, Maryland, Michigan, North Carolina, Virginia, and Washington; the State mine inspectors of Alabama, Indiana, Iowa, Kentucky, North Dakota, Tennessee, Texas, and West Virginia; the Pennsylvania State Department of Mines; the Department of Industrial Relations of Ohio; and the United States Bureau of Mines have cooperated in the collection of reports.

The compilation of the annual statistics of bituminous coal, the principal task underlying this report, was conducted by Miss L. Mann, of the United States Geological Survey, with the assistance of Miss J. M. Corse. The statistics of anthracite were compiled by Mrs. H. L. Bennit. The weekly and monthly estimates of production are prepared by Miss R. M. McKinney, under the supervision of W. F. McKenney. The canvass of wagon mines in 1923 and the tables of shipments by originating carriers were handled by Mrs. E. E. Finn under the supervision of Mr. McKenney. The tables of exports and imports were compiled by J. A. Dorsey from the records of the Bureau of Foreign and Domestic Commerce. F. G. Tryon was in charge of the work and in collaboration with L. Mann wrote the text of this report.

The manuscript and proof have been critically reviewed by James E. Black, to whom the authors are deeply indebted.

STATISTICAL SUMMARY OF COAL MINING IN 1923

SALIENT FEATURES

The salient features of the statistics of coal mining in 1923 for the United States as a whole are given in Table 1. Table 2 gives the primary data by States, with comparable figures for 1921 and 1922. Table 3 is a summary of production and consumption for the 11-year period 1913 to 1923.

TABLE 1.—*Salient statistics of the coal industry in 1923*

[Figures for bituminous coal represent net tons; for anthracite, gross tons]

	Bituminous coal	Anthracite
Production……tons..	564, 564, 662	83, 338, 401
Value at mines……	$1, 514, 621, 000	$506, 787, 000
Average value per ton……	$2. 68	$6. 08
Average spot price as quoted by Coal Age……	$2. 77	(a)
Stocks of commercial consumers:		
January 1……tons..	36, 000, 000	(a)
December 31……do….	62, 000, 000	(a)
Net change during year……do….	+26, 000, 000	(a)
Exports……do….	21, 454, 000	4, 545, 000
Imports……do….	1, 882, 000	268, 000
Consumption (calculated)……do….	518, 993, 000	[b] 77, 601, 000
Annual capacity (308 working days) of mines with present labor force..do….	970, 000, 000	(a)
Average number of days worked……	179	268
Average days idle:		
All causes……	129	36
Through strikes and lockouts……	2	17
Other causes……	127	19
Average number employed……	704, 793	157, 743
Miners, loaders, and shot firers……	422, 040	72, 362
Other underground……	178, 265	42, 359
Surface……	104, 488	43, 022
Output per man per day……tons..	4. 47	[c] 2. 21
Number of cutting machines……	21, 229	(a)
Quantity cut by machines……tons..	377, 435, 543	1, 079, 055
Per cent of output cut by machines……	66. 9	1. 3
Number of power shovels in strip pits……	442	95
Quantity produced by stripping……tons..	11, 844, 347	2, 020, 623

[a] Data not available.

[b] Allowing for an increase of 1,460,000 tons in the stocks of producers in 1923.

[c] Net tons.

TABLE 2.—*Summary of coal produced, value, men employed, and days worked, by States, 1921–1923*

[Figures for 1921 do not include product of wagon mines]

State	Loaded at mines for shipment (net tons)	Sold to local trade and used by employees (net tons)	Used at mines for steam and heat (net tons)	Made into coke at mines (net tons)	Total quantity (net tons)	Total value	Average value per ton	Number of employees				Average number of days worked
								Underground		Surface	Total	
								Miners, loaders, etc. [a]	All others			
1921												
Alabama	11, 834, 609	313, 125	292, 807	128, 358	12, 568, 899	$38, 713, 000	$3. 08	15, 304	5, 869	4, 636	25, 809	166
Alaska	71, 999	3, 005	1, 813		76, 817	496, 000	6. 46	104	79	218	401	244
Arkansas	1, 174, 584	19, 477	33, 716		1, 227, 777	5, 360, 000	4. 37	2, 315	848	453	3, 616	112
California, Idaho, and Oregon	19, 015	13, 305	6, 525		38, 845	181, 000	4. 66	35	48	58	141	149
Colorado	8, 408, 613	399, 816	253, 718	60, 613	9, 122, 760	32, 377, 000	3. 55	8, 456	3, 450	2, 623	14, 529	164
Georgia	18, 755	373	1, 979	12, 708	33, 815	171, 000	2. 14	59	26	51	136	183
Illinois	64, 174, 112	3, 371, 482	2, 057, 169		69, 602, 763	190, 986, 000	2. 74	60, 466	25, 043	9, 922	95, 431	152
Indiana	19, 116, 259	610, 620	592, 630		20, 319, 509	52, 269, 000	2. 57	20, 472	8, 460	3, 755	32, 687	128
Iowa	3, 891, 368	521, 465	118, 559		4, 531, 392	17, 256, 800	3. 81	7, 597	2, 815	974	11, 386	148
Kansas	3, 250, 299	111, 448	104, 894		3, 466, 641	13, 333, 300	3. 85	5, 453	1, 538	1, 216	8, 207	137
Kentucky	30, 096, 762	802, 744	527, 257	161, 507	31, 588, 270	85, 092, 600	2. 69	28, 737	12, 996	8, 788	50, 521	152
Maryland	1, 743, 710	56, 734	27, 296		1, 827, 740	6, 602, 000	3. 61	2, 964	978	726	4, 668	120
Michigan	1, 058, 789	11, 354	71, 572		1, 141, 715	5, 555, 000	4. 87	1, 346	622	244	2, 212	196
Missouri	3, 209, 496	242, 136	99, 989		3, 551, 621	13, 915, 500	3. 92	5, 141	1, 830	1, 584	8, 555	166
Montana	2, 492, 344	115, 538	126, 076		2, 733, 958	8, 921, 600	3. 26	2, 396	1, 064	718	4, 178	143
New Mexico	2, 326, 034	34, 754	62, 259	30, 435	2, 453, 482	9, 585, 000	3. 91	2, 735	1, 120	722	4, 577	150
North Carolina	20, 000		3, 438		23, 438	135, 000	5. 76	38	7	15	60	300
North Dakota	700, 950	135, 550	28, 403		864, 903	2, 329, 500	2. 69	566	209	289	1, 064	194
Ohio	29, 788, 393	1, 559, 953	594, 243	187	31, 942, 776	84, 686, 500	2. 65	33, 143	11, 555	7, 087	51, 785	134
Oklahoma	3, 208, 381	25, 559	128, 683		3, 362, 623	15, 546, 000	4. 62	5, 000	2, 425	1, 429	8, 854	141
Pennsylvania (bituminous)	102, 025, 340	4, 315, 590	2, 552, 372	7, 120, 640	116, 013, 942	322, 538, 300	2. 78	119, 818	44, 404	26, 421	190, 643	151
South Dakota	450	7, 069	34		7, 553	21, 200	2. 81	43			43	129
Tennessee	4, 194, 364	88, 199	123, 730	54, 033	4, 460, 326	14, 932, 000	3. 35	6, 061	2, 500	1, 786	10, 347	154
Texas	947, 589	2, 691	22, 559		972, 839	2, 563, 600	2. 64	1, 989	609	294	2, 892	139
Utah	3, 668, 661	74, 705	73, 365	262, 053	4, 078, 784	13, 662, 000	3. 35	2, 450	1, 041	931	4, 422	151
Virginia	6, 818, 178	152, 729	98, 950	422, 521	7, 492, 378	22, 947, 700	3. 06	5, 751	4, 056	2, 115	11, 922	166
Washington	2, 274, 202	59, 644	88, 585	6, 291	2, 428, 722	9, 787, 000	4. 03	2, 241	1, 245	848	4, 334	159
West Virginia	68, 655, 196	2, 983, 061	808, 609	340, 130	72, 786, 996	206, 661, 500	2. 84	53, 801	30, 951	17, 098	101, 850	149
Wyoming	6, 875, 284	103, 495	221, 887		7, 200, 666	23, 358, 500	3. 24	4, 789	2, 231	1, 464	8, 484	167
Total bituminous	382, 063, 736	16, 135, 621	9, 123, 117	8, 599, 476	415, 921, 950	1, 199, 983, 600	2. 89	399, 270	168, 019	96, 465	663, 754	140
Pennsylvania anthracite	77, 901, 110	2, 812, 551	9, 759, 790		90, 473, 451	452, 305, 000	5. 00	73, 977	42, 840	42, 682	159, 499	271
Grand total	459, 964, 846	18, 948, 172	18, 882, 907	8, 599, 476	506, 395, 401	1, 652, 288, 600	3. 26	473, 247	210, 859	139, 147	823, 253	173

[a] Includes also shot firers.

TABLE 2.—*Summary of coal produced, value, men employed, and days worked, by States, 1921–1923*—Continued

State	Loaded at mines for shipment (net tons)	Sold to local trade and used by employees (net tons)	Used at mines for steam and heat (net tons)	Made into coke at mines (net tons)	Total quantity (net tons)	Total value	Average value per ton	Number of employees				Average number of days worked
								Underground		Surface	Total	
								Miners, loaders, etc. [a]	All others			
1922												
Alabama	17, 376, 060	360, 811	290, 187	297, 682	18, 324, 740	$42, 856, 000	$2. 34	16, 615	6, 528	5, 026	28, 169	215
Alaska	76, 111	1, 221	1, 943		79, 275	431, 000	5. 43	149	113	168	430	147
Arkansas	1, 066, 751	15, 112	28, 183		1, 110, 046	4, 592, 000	4. 14	2, 386	973	676	4, 035	81
California, Idaho, and Oregon	17, 011	3, 662	6, 220		26, 893	104, 000	3. 87	20	25	15	60	250
Colorado	9, 144, 680	542, 783	232, 255	99, 879	10, 019, 597	31, 701, 000	3. 16	7, 911	3, 158	2, 437	13, 506	191
Georgia	41, 809	535	2, 114	16, 178	60, 636	246, 000	4. 06	68	23	59	150	242
Illinois	53, 695, 042	3, 227, 015	1, 545, 679		58, 467, 736	168, 925, 000	2. 89	61, 592	24, 704	10, 040	96, 336	120
Indiana	18, 142, 677	537, 310	452, 902		19, 132, 889	54, 524, 000	2. 85	20, 605	8, 288	4, 315	33, 208	110
Iowa	3, 653, 352	579, 907	101, 902		4, 335, 161	16, 119, 000	3. 72	8, 369	3, 477	1, 011	12, 857	131
Kansas	2, 797, 291	96, 831	61, 048		2, 955, 170	10, 816, 000	3. 66	5, 093	1, 319	947	7, 359	125
Kentucky	40, 554, 793	991, 145	534, 578	53, 659	42, 134, 175	127, 037, 000	3. 02	34, 189	16, 207	10, 528	60, 924	140
Maryland	1, 165, 738	44, 676	12, 293		1, 222, 707	4, 122, 000	3. 37	2, 563	663	529	3, 755	101
Michigan	855, 917	13, 814	59, 659		929, 390	4, 693, 000	5. 05	1, 335	639	192	2, 166	162
Missouri	2, 620, 074	228, 327	76, 349		2, 924, 750	11, 153, 000	3. 81	5, 370	1, 848	1, 532	8, 750	113
Montana	2, 395, 091	92. 413	84, 717		2, 572, 221	8, 208, 500	3. 19	2, 194	904	537	3, 635	140
New Mexico	2, 871, 424	35, 931	57, 479	182, 339	3, 147, 173	10, 977, 000	3. 49	2, 253	969	779	4, 001	216
North Carolina	68, 524	1, 500	8, 546		78, 570	388, 000	4. 94	50	45	32	127	167
North Dakota	1, 078, 139	211, 193	38, 232		1, 327, 564	3, 513, 000	2. 65	846	290	512	1, 648	175
Ohio	24, 434, 491	1, 953, 222	566, 078		26, 953, 791	87, 056, 000	3. 23	34, 134	11, 772	8, 288	54, 194	100
Oklahoma	2, 627, 406	28, 381	146, 724		2, 802, 511	11, 527, 000	4. 11	4, 390	2, 234	1, 204	7, 828	114
Pennsylvania (bituminous)	94, 939, 698	5, 130, 548	2, 214, 591	10, 863, 471	113, 148, 308	351, 777, 000	3. 11	114, 541	44, 910	29, 387	188, 838	154
South Dakota	450	7, 302			7, 752	22, 000	2. 84	32			32	138
Tennessee	4, 546, 552	111, 977	113, 854	104, 391	4, 876, 774	14, 096, 000	2. 89	6, 996	2, 537	1, 916	11, 449	163
Texas	1, 076, 595	12, 557	16, 855		1, 106, 007	2, 563, 000	2. 32	1, 994	541	306	2, 841	185
Utah	4, 530, 382	61, 930	99, 282	300, 414	4, 992, 008	15, 687, 500	3. 14	2, 302	1, 327	1, 092	4, 721	204
Virginia	9, 650, 588	156, 354	100, 020	584, 212	10, 491, 174	27, 083, 000	2. 58	6, 290	4, 567	2, 542	13, 399	198
Washington	2, 392, 305	63, 135	84, 700	41, 025	2, 581, 165	10, 279, 000	3. 98	2, 434	1, 170	877	4, 481	194
West Virginia	76, 150, 385	2, 918, 643	709, 139	710, 025	80, 488, 192	236, 162, 000	2. 93	57, 785	33, 029	19, 200	110, 014	143
Wyoming	5, 708, 071	77, 914	185, 739		5, 971, 724	18, 162, 000	3. 04	5, 266	2, 377	1, 402	9, 045	124
Total bituminous, including wagon mines	383, 677, 407	17, 506, 149	7, 831, 268	13, 253, 275	422, 268, 099	1, 274, 820, 000	3. 02	407, 772	174, 637	105, 549	687, 958	142
Pennsylvania anthracite	46, 002, 699	2, 378, 200	6, 302, 123		54, 683, 022	273, 700, 000	5. 01	72, 527	41, 752	42, 570	156, 849	151
Grand total	429, 680, 106	19, 884, 349	14, 133, 391	13, 253, 275	476, 951, 121	1, 548, 520, 000	3. 25	480, 299	216, 389	148, 119	844, 807	148

1923												
Alabama	19, 520, 634	370, 754	307, 356	258, 905	20, 457, 649	$51, 624, 000	$2. 52	17, 304	7, 330	5, 401	30, 035	232
Alaska	104, 867	12, 734	2, 225		119, 826	755, 000	6. 30	73	48	78	199	220
Arkansas	1, 245, 350	12, 845	38, 697		1, 296, 892	5, 192, 000	4. 01	2, 124	846	784	3, 754	97
California, Idaho, and Oregon	11, 256	1, 555	7, 255		20, 066	79, 000	3. 94	43	26	24	93	206
Colorado	9, 390, 124	534, 464	231, 595	190, 035	10, 346, 218	33, 299, 000	3. 22	8, 064	3, 114	2, 162	13, 340	[b]174
Georgia	48, 172	733	2, 554	24, 161	75, 620	327, 000	4. 32	69	23	75	167	231
Illinois	73, 842, 388	3, 606, 769	1, 860, 918		79, 310, 075	198, 388, 000	2. 50	64, 194	24, 900	10, 620	99, 714	158
Indiana	24, 951, 649	697, 832	579, 618		26, 229, 099	65, 046, 000	2. 48	22, 777	8, 228	4, 403	35, 408	136
Iowa	5, 027, 502	556, 180	127, 053		5, 710, 735	20, 517, 000	3. 59	7, 797	2, 709	942	11, 448	181
Kansas	4, 092, 792	268, 082	82, 275		4, 443, 149	14, 275, 000	3. 21	6, 966	1, 662	1, 133	9, 761	139
Kentucky	43, 149, 962	844, 094	552, 943	230, 318	44, 777, 317	113, 542, 000	2. 54	33, 911	16, 546	10, 354	60, 811	152
Maryland	2, 181, 688	77, 823	26, 415		2, 285, 926	6, 911, 000	3. 02	2, 360	814	551	3, 725	178
Michigan	1, 086, 198	16, 235	69, 642		1, 172, 075	5, 545, 000	4. 73	1, 213	580	184	1, 977	222
Missouri	3, 101, 275	211, 447	90, 429		3, 403, 151	11, 575, 000	3. 40	4, 217	1, 335	1, 400	6, 952	155
Montana	2, 934, 829	118, 060	94, 789		3, 147, 678	9, 652, 000	3. 07	2, 054	910	547	3, 511	179
New Mexico	2, 572, 465	38, 684	46, 689	257, 335	2, 915, 173	10, 668, 000	3. 66	2, 522	1, 025	548	4, 095	216
North Carolina	29, 419	1, 700	4, 900		36, 019	132, 000	3. 66	55	70	25	150	275
North Dakota	1, 128, 318	218, 574	38, 508		1, 385, 400	3, 275, 000	2. 36	883	257	481	1, 621	182
Ohio	37, 273, 886	2, 672, 268	600, 289		40, 546, 443	98, 610, 000	2. 43	34, 121	12, 225	8, 209	54, 555	150
Oklahoma	2, 722, 387	37, 998	117, 022	7, 631	2, 885, 038	10, 874, 000	3. 77	4, 100	1, 930	1, 100	7, 130	133
Pennsylvania (bituminous)	138, 275, 133	7, 359, 213	2, 507, 227	23, 738, 340	171, 879, 913	472, 217, 000	2. 75	120, 385	46, 183	28, 413	194, 981	213
South Dakota	2, 000	8, 379			10, 379	25, 000	2. 41	34			34	122
Tennessee	5, 614, 117	119, 657	115, 783	190, 711	6, 040, 268	16, 515, 000	2. 73	6, 752	2, 733	1, 759	11, 244	183
Texas	1, 156, 901	6, 564	23, 864		1, 187, 329	2, 162, 000	1. 82	1, 641	493	318	2, 452	178
Utah	4, 179, 293	56, 471	81, 399	403, 054	4, 720, 217	13, 657, 000	2. 89	2, 379	1, 063	939	4, 381	160
Virginia	10, 292, 691	212, 131	96, 041	1, 160, 780	11, 761, 643	32, 468, 000	2. 76	6, 810	4, 841	2, 469	14, 120	212
Washington	2, 697, 984	80, 881	87, 973	59, 554	2, 926, 392	10, 894, 000	3. 72	2, 313	1, 147	846	4, 306	213
West Virginia	101, 961, 199	3, 841, 346	758, 904	1, 338, 492	107, 899, 941	285, 481, 000	2. 65	62, 676	35, 207	19, 417	117, 300	169
Wyoming	7, 264, 816	97, 567	212, 648		7, 575, 031	20, 916, 000	2. 76	4, 203	2, 020	1, 306	7, 529	192
Total bituminous, including wagon mines	505, 859, 295	22, 081, 040	8, 765, 011	27, 859, 316	564, 564, 662	1, 514, 621, 000	2. 68	422, 040	178, 265	104, 488	704, 793	179
Pennsylvania anthracite	82, 239, 037	3, 248, 352	7, 851, 620		93, 339, 009	506, 787, 000	5. 43	72, 362	42, 359	43, 022	157, 743	268
Grand total	588, 098, 332	25, 329, 392	16, 616, 631	27, 859, 316	657, 903, 671	2, 021, 408, 000	3. 07	494, 402	220, 624	147, 510	862, 536	195

[a] Includes also shot firers.

[b] See note [b], page 658

TABLE 3.—*Production, imports, exports, and home consumption of anthracite and bituminous coal, 1913–1923, in net tons*

[Data on production, consumption, and stocks largely from U. S. Geological Survey reports; import and export figures from records of Bureau of Foreign and Domestic Commerce]

Calendar year	Production	Imports	Exports to—		Net change in stocks [a]	Consumption in the United States [b]
			Canada and Mexico	Other countries (sea-borne)		
Anthracite:						
1913	91, 525, 000	[c] 2, 000	4, 573, 000	80, 000	+1, 400, 000	85, 474, 000
1914	90, 822, 000	[c] 9, 000	4, 220, 000	70, 000	+2, 500, 000	84, 041, 000
1915	88, 995, 000	[c] 14, 000	3, 854, 000	111, 000	−3, 100, 000	88, 144, 000
1916	87, 578, 000	6, 000	4, 558, 000	108, 000	−4, 200, 000	87, 118, 000
1917	99, 612, 000	13, 000	5, 917, 000	90, 000	−450, 000	94, 068, 000
1918	98, 826, 000	37, 000	4, 910, 000	58, 000	+1, 120, 000	92, 775, 000
1919	88, 092, 000	83, 000	4, 871, 000	106, 000	+1, 680, 000	81, 518, 000
1920	89, 598, 000	32, 000	4, 987, 000	417, 000	−1, 560, 000	85, 786, 000
1921	90, 473, 000	9, 000	4, 569, 000	108, 000	+3, 855, 000	81, 950, 000
1922	54, 683, 000	234, 000	2, 579, 000	70, 000	−4, 530, 000	56, 798, 000
1923	93, 339, 000	300, 000	4, 993, 000	97, 000	+1, 635, 000	86, 914, 000
Bituminous coal:						
1913	478, 436, 000	1, 583, 000	15, 650, 000	4, 495, 000	([d])	459, 874, 000
1914	422, 704, 000	1, 546, 000	10, 674, 000	4, 784, 000	([d])	408, 792, 000
1915	442, 624, 000	1, 709, 000	9, 670, 000	9, 107, 000	([d])	425, 556, 000
1916	502, 520, 000	1, 714, 000	13, 481, 000	7, 774, 000	−11, 000, 000	493, 979, 000
1917	551, 791, 000	1, 448, 000	18, 324, 000	5, 506, 000	No change.	529, 409, 000
1918	579, 386, 000	1, 457, 000	18, 316, 000	4, 034, 000	+27, 900, 000	530, 593, 000
1919	465, 860, 000	1, 012, 000	12, 064, 000	8, 050, 000	−34, 900, 000	481, 658, 000
1920	568, 667, 000	1, 245, 000	16, 458, 000	22, 059, 000	+22, 800, 000	508, 595, 000
1921	415, 922, 000	1, 258, 000	13, 590, 000	9, 541, 000	+2, 200, 000	391, 849, 000
1922	422, 268, 000	5, 060, 000	10, 938, 000	1, 475, 000	−12, 000, 000	426, 915, 000
1923	564, 565, 000	1, 882, 000	16, 960, 000	4, 494, 000	+26, 000, 000	518, 993, 000

[a] Figures for anthracite represent producers' stocks; for bituminous coal, consumers' stocks. Plus sign denotes coal produced but added to stocks and not consumed; minus sign denotes coal consumed that was withdrawn from stocks carried over from preceding year. Anthracite data from Federal Trade Commission Cost Reports (Coal, No. 2, p. 27), and Hearings before Frelinghuysen Coal Committee, Senate Res. 126, 66th Cong., 1st sess., pt. 1, p. 308. These anthracite figures through 1918 represent coal years, since then, calendar years, and are in part estimates. Bituminous data from reports on consumers' stocks of bituminous coal, issued by United States Geological Survey, and article, "Is the coal shortage real or imaginary?" (Coal Age, Aug. 26, 1920, p. 429), by C. E. Lesher, formerly coal statistician, United States Geological Survey, and director of Statistical Division, United States Fuel Administration.

[b] Production plus imports and minus exports, plus or minus the decrease or increase, respectively, represented by the net change in coal stocks.

[c] Fiscal year ended June 30.

[d] No data available.

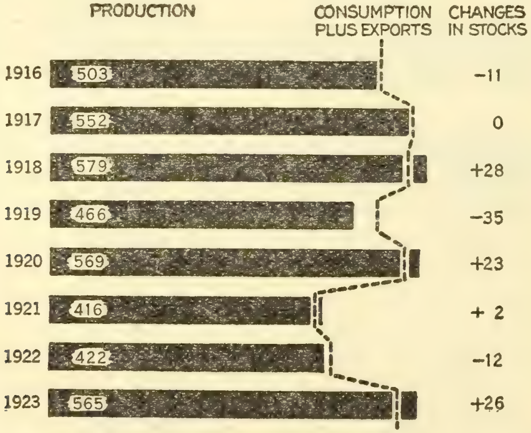


FIGURE 22.—Production of bituminous coal compared to consumption and export, 1916–1923. Bars represent production; dotted line, the sum of consumption and net exports. Consumption has fluctuated much less sharply than production, the differences being explained by the flow of coal in and out of consumers' storage

BITUMINOUS-COAL TRADE IN 1923

In the bituminous-coal fields 1923 was a year of truce in labor relations—a year of recovery after the upheaval of the great strike of 1922. The shortage created by that strike dominated the market for months and buoyed up demand above the level of current consumption. The comparatively high spot prices in the first six months and the heavy buying which continued throughout the year obscured the causes of instability latent in the industry. Yet by the end of the year signs were not lacking of the severe and unequal competition which was to become so dominant in 1924.

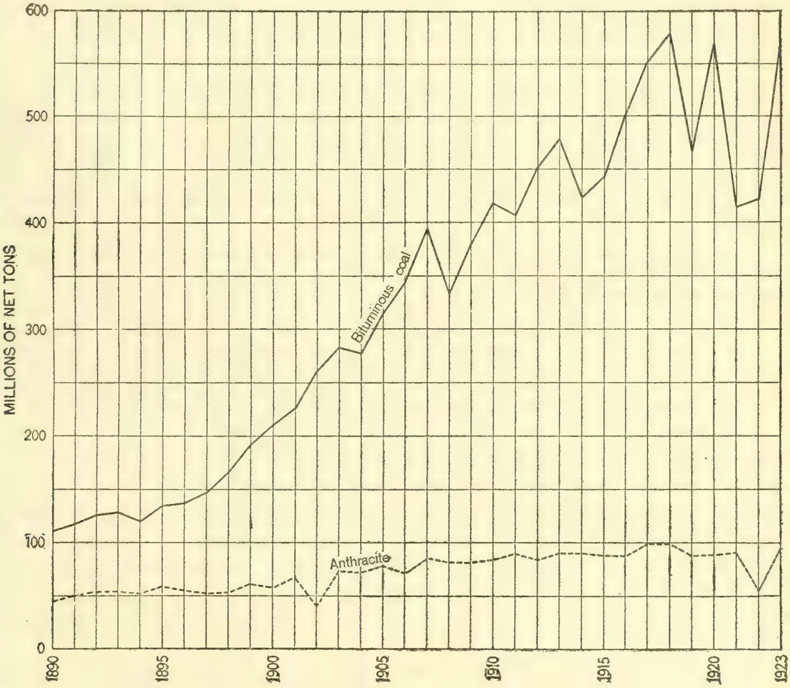


FIGURE 23.—Bituminous coal and anthracite produced, 1890–1923

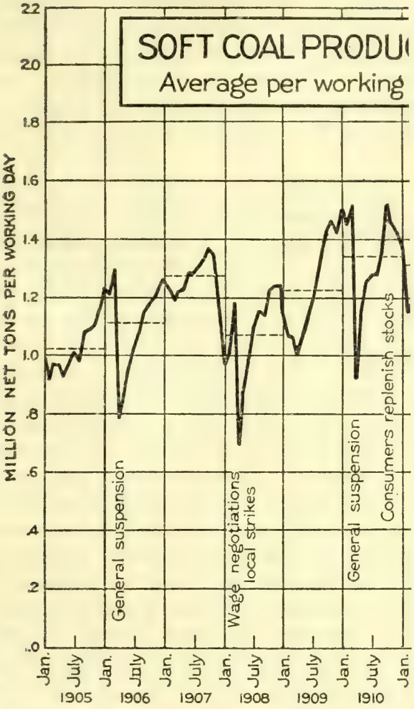
Labor relations in 1923.—On January 1 the union bituminous mines were operating under the Cleveland agreement, by which the strike of 1922 had been ended and which was to run until March 31, 1923. By this agreement the union won its fight against a reduction of the wage scale. The peak rates of 1920 were retained, including the advance of $1.50 to daymen in the summer of that year, which carried the day scale to $7.50. Under these rates, as illustrated by the Indiana scale, which is roughly typical of the union fields, pick miners were receiving 77 per cent more than in 1912, machine loaders 104 per cent, and inside daymen 164 per cent.

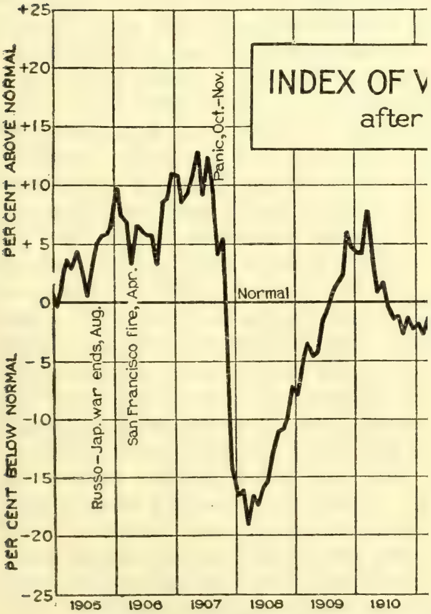
Although some apprehension was felt among union employers as to their ability to pay the scale, no serious opposition to a renewal of the agreement arose. The United States Coal Commission, which had been created in September, 1922, urged that the agreement be extended for another year, until it should have time to complete its studies and make its report, and after some discussion a contract was signed by representatives of Illinois, Indiana, and Ohio at New York on January 24 to run from April 1, 1923, to March 31, 1924, which continued the existing scale. Although Pittsburgh was not represented, the contract was believed to mark a return to the method of bargaining through the Central Competitive Field, which had been abandoned for other methods in July, 1920, and August, 1922; and Pittsburgh and the outlying districts quickly negotiated corresponding agreements.

The market.—In thus renewing the scale with its $7.50 day rate, the union operators were influenced by the state of the market. For the moment nonunion and union wages and costs were on a parity, and the competition of nonunion coal was not oppressive. Demand was active, and prices, though declining, were still high. (See fig. 28.) The industries of the country were recovering from the great depression of 1921, and consumption was increasing. (See fig. 22 and Pl. VI.) In March, April, and May the production of pig iron established a new high record and the consumption of coal in the manufacture of coke was close to the war-time maximum of October, 1918. Added to purchases for current consumption was a heavy demand for storage. At the end of the strike of 1922 stocks had fallen to 22,000,000 tons. By January 1, 1923, they had risen to 36,000,000 tons, but this was far short of the level which consumers desired to maintain. Buying for storage continued heavy throughout the summer of 1923. Figures 25–27 show the steady flow of coal into storage. In consequence the usual summer decline in output did not appear, and the curve of production (fig. 24) shows remarkably little change from week to week. By July 1 stocks had risen to 46,000,000 tons, a level which would have been deemed sufficient in some other years, but buying for storage continued, partly because the recollection of the shortage of 1922 was still fresh in the minds of consumers, partly because as the expiration of the agreement drew near the possibility of another stoppage was sensed. By December 31 the very large reserve of 62,000,000 tons had been built up.

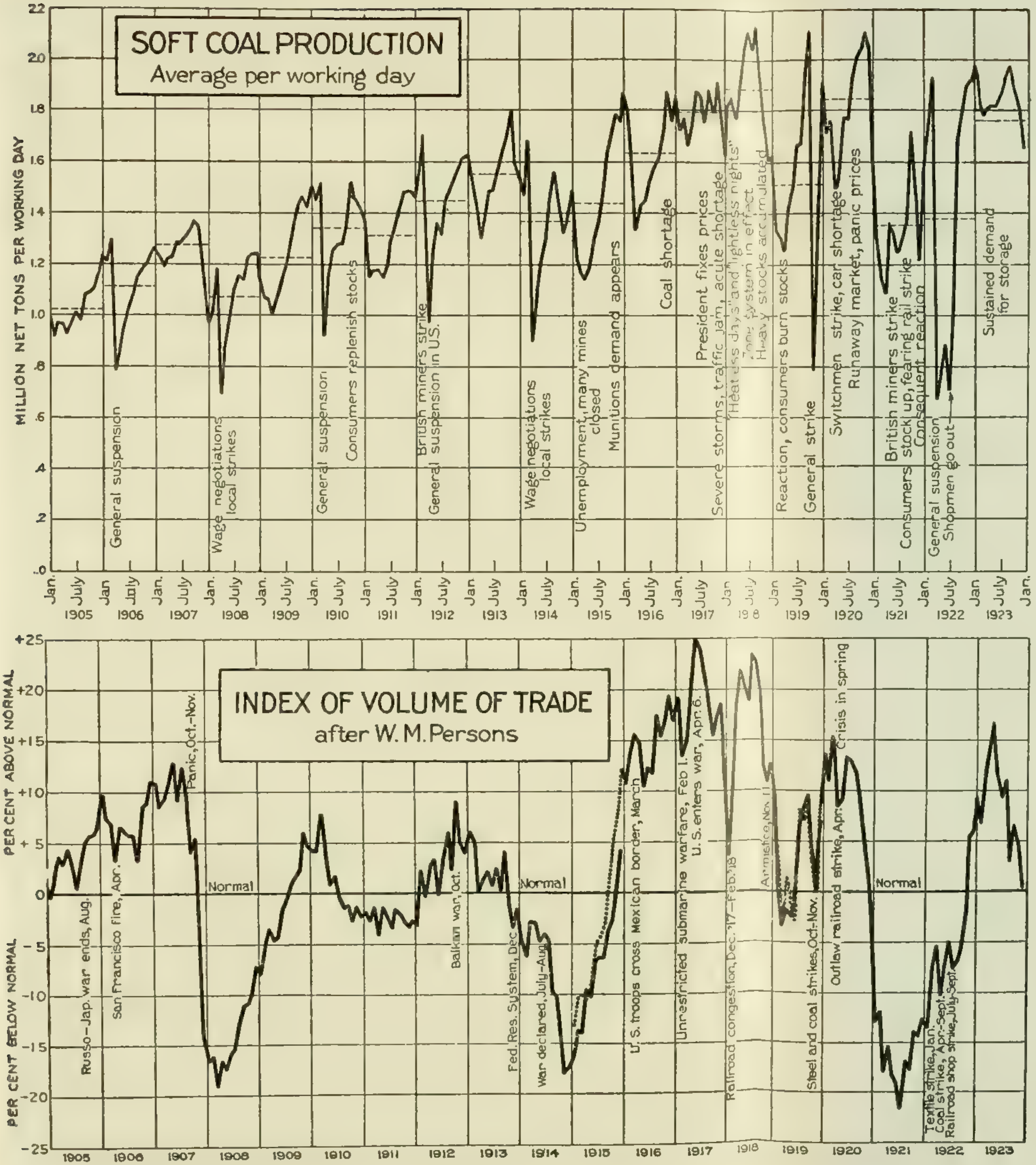
The total quantity of bituminous coal added to consumers' stocks in 1922 was thus 26,000,000 tons. The production for the year was 565,000,000 tons, or more than that of 1917 and second only to that of 1918 and 1920.

Transportation.—The heavy production of 1923 was handled by the railroads with far less complaint of car shortage than in other years of large output. The after effects of the strike of the railway shopmen that broke out July 1, 1922, were apparent in the transportation service in the following winter, and car shortage and other forms of transportation disability were reported at many mines in January, February, and March. Thereafter the railroads handled the coal offered with remarkable facility and dispatch. The improvement over other years of heavy coal traffic was due to a number of causes. Coal-carrying facilities had been increased, and greater operating efficiency was obtained. Not the least factor was the offering of the coal traffic of 1923 to the railroads in reasonably even installments, instead of in extremes as low as 3,700,000 tons a week and as high as





MONTHLY FLUCTUATIONS IN OU



MONTHLY FLUCTUATIONS IN OUTPUT OF BITUMINOUS COAL AND IN VOLUME OF TRADE, 1905-1923

13,000,000 tons, such as had characterized the preceding years. The experience of 1923 was thus a practical demonstration of the possibility of equalizing coal shipments through off-season storage and in thereby handling maximum quantities of coal without great additional investment in railroad equipment and facilities. To this equalizing of coal traffic the railroads largely contributed through their far-sighted program of summer storage of their own fuel. (See fig. 27.)[1]

Prices in 1923.—As consumers' stocks were accumulating spot prices were declining (fig. 28). In January, when the wage agreement was signed, Coal Age's weighted average price of 14 coals f. o. b. mine stood at $4.38. At this price it was possible for the high-cost commercial mines and thousands of wagon mines to operate. But as stocks increased prices dropped, until in June they reached $2.56. By this time the wagon mines had closed and the smaller commercial operations were following their example. Shipments under contract continued in heavy volume, but the gradual decline in open-market prices left less and less room for profit on spot sales. Pressure to reduce costs followed, and before the end of the year wage cuts were reported in some of the nonunion fields.

Idle, part-time, and full-time mines.—Significant of market developments in 1923 is the changing proportion of full-time, part-time, and idle mines among the 2,500 commercial operations that were reporting weekly to the Geological Survey (fig. 29). The mines included in the Survey's weekly statement were substantially the same from week to week, and the reports are comparable. These were not wagon mines, but commercial operations of some size. Altogether, the 2,500 mines yield about one-half of the output of the country, and they may be taken as fairly representative of the commercial as distinct from the consumer-owned output.

In Figure 29 each bar represents the condition of these 2,500 mines of a typical week. The sections of the bar stand for the percentage in the total number of mines that were entirely idle in that week and the percentage that worked 1 day, 2 days, and so on up to 6 days, or full time. Now, in October, 1922, just after the great strike, when prices were high and car shortage was prevalent, practically all mines that could get cars at all were in operation, and only 4.2 per cent of the total mines reporting were idle. Another 8.8 per cent worked one day, 26 per cent worked 2 days, 25 per cent 3 days, and so on to the group working 6 days, which constituted 13.1 per cent of the total. The next bar shows the condition in the week of February 17, 1923, after the renewal of the wage agreement was assured and the effects of the great strike were rapidly disappearing. Demand was still very active and the number of mines closed had increased but slightly. Production of the mines at work was limited chiefly by the available car supply, and few mines were able to get both cars and orders sufficient for full-time operation. As 1923 passed the market grew less and less active. More and more properties closed, with the result that in the week of November 17, 32 per cent of the mines reporting to the Survey were idle, a percentage almost four times as great as that in the preceding February. Not less significant than the increase in idle mines was an increase at the other end of the

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[1] See Tryon, F. G., and McKenney, W. F., International Railway Fuel Assoc. Proc., 1924, pp. 210-239.

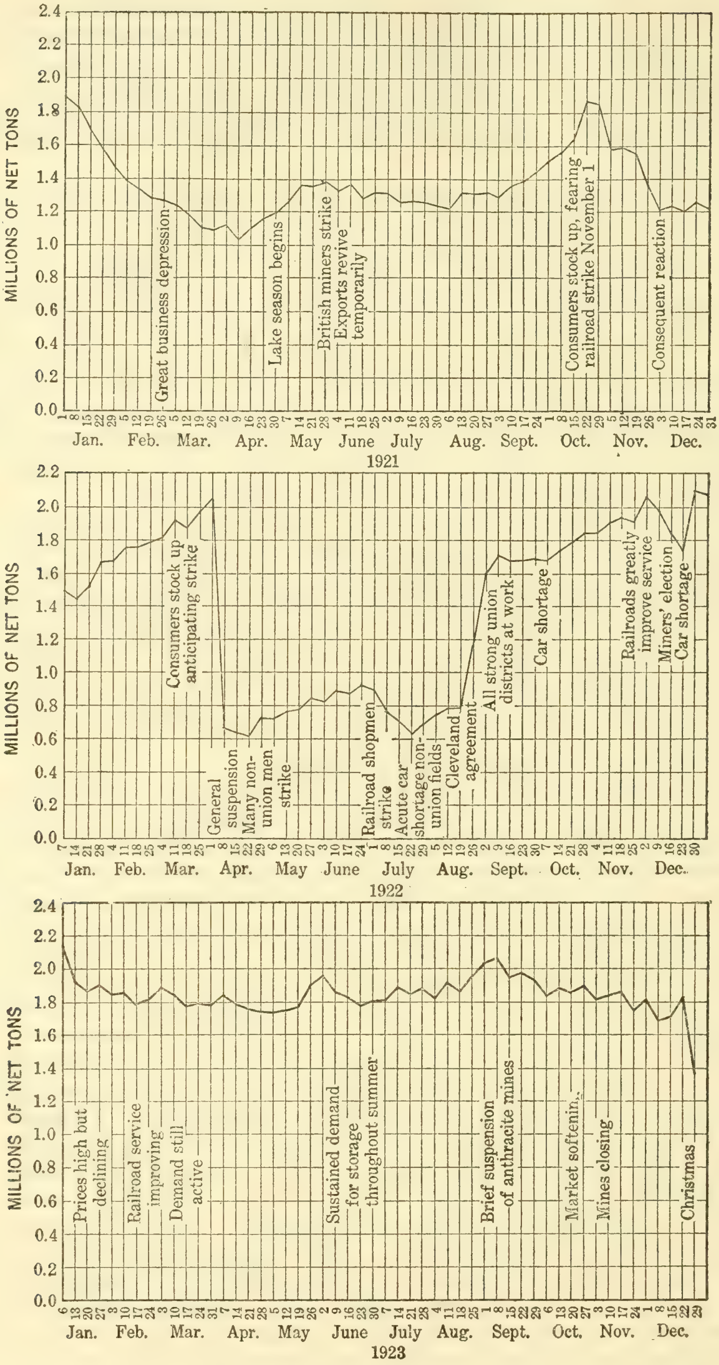

FIGURE 24.—Average production of soft coal per working day for each week, 1921–1923

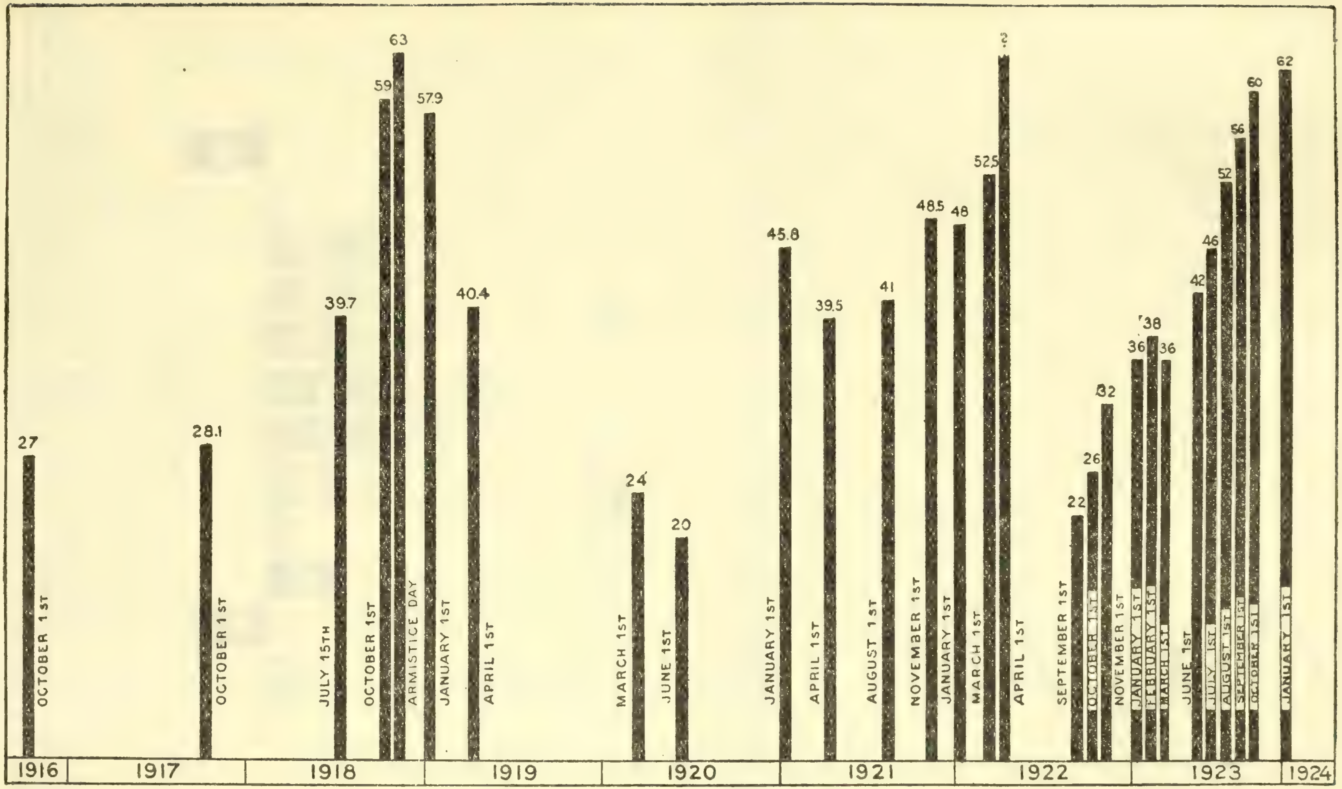

FIGURE 25.—Total commercial stocks of bituminous coal, October 1, 1916, to January 1, 1924. Figures represent millions of net tons and include coal in the hands of railroads, industrial consumers, public utilities, and retail dealers. Coal for steamship fuel, on Lake docks, in transit, and in the bins of householders is not included.

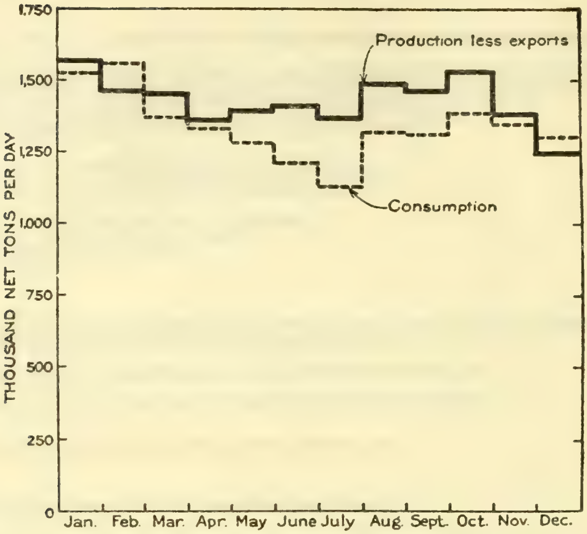

FIGURE 26.—Monthly production and consumption of soft coal in 1923. Production was very steady in 1923, but consumption showed the characteristic summer drop. The interval between the two lines of the diagram represents changes in stocks, including reserves on the Lake docks. These changes are shown in more detail in the succeeding diagram

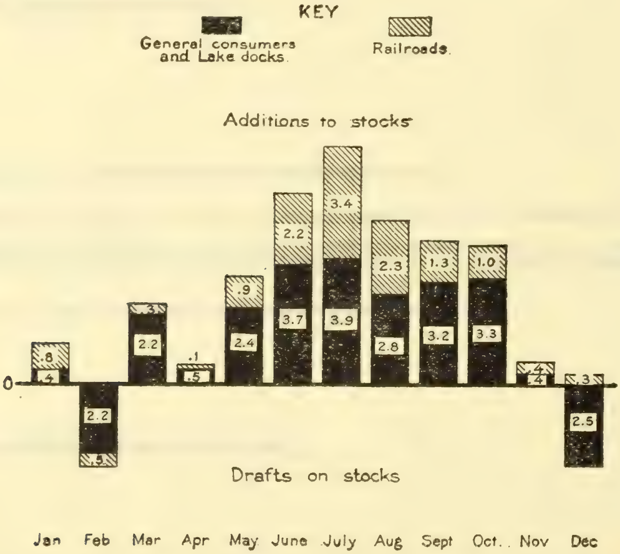

FIGURE 27.—Monthly changes in stocks in 1923. Storage of very large quantities during the summer explains the steady production of soft coal in 1923. Some coal was drawn from stocks during the traffic congestion of February, but additions to stock (shown by the columns above the zero line) were made in every month thereafter until December. The maximum addition was made in July, when the railroads alone put into storage 3.4 million tons. Figures in columns represent millions of net tons

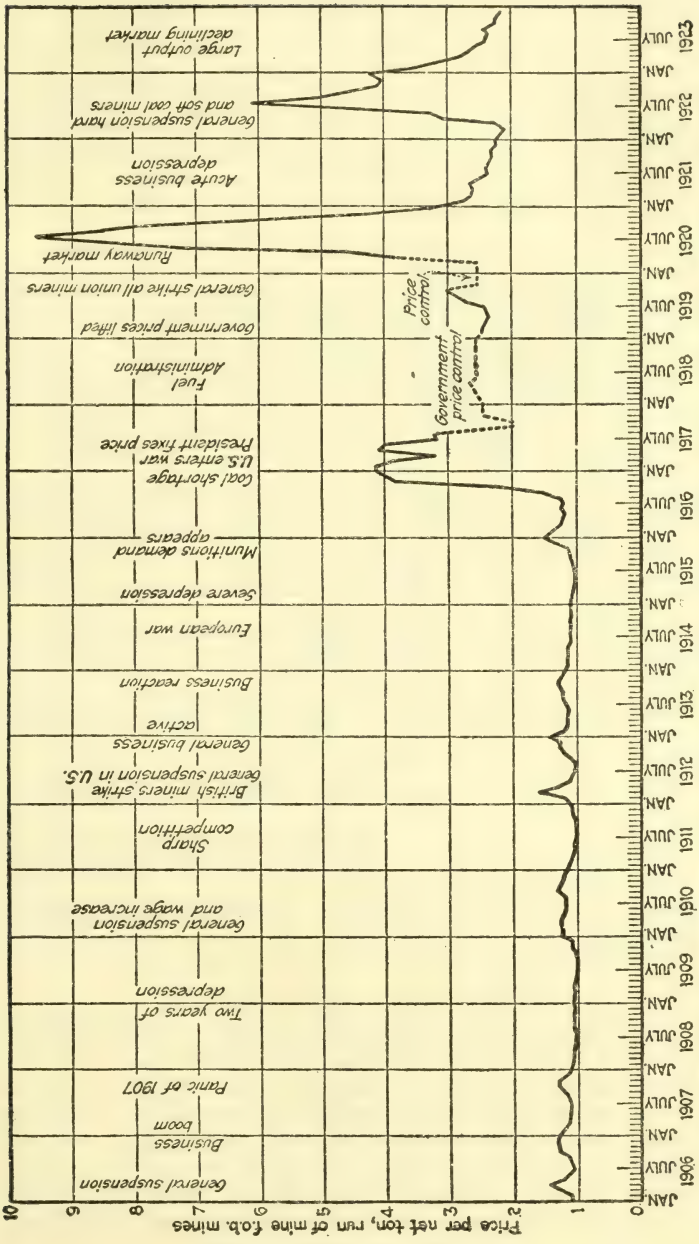

FIGURE 28.—Monthly average spot prices of bituminous coal f. o. b. mines, 1923, as quoted by Coal Age. Data in Table 62, p. 621

scale in the number of mines working full time. By November, 1923, 14.8 per cent were working practically at capacity, and this included a large share of the biggest mines.

Thus before the agreement of 1923 had run its span of one year the competitive forces of unsettlement in the bituminous-coal industry began to reappear. Even in a period of active demand the market could not absorb the potential output of the existing mines. Overdevelopment was forcing intense competition, and already the nonunion fields, free to reduce costs by cutting wages, were beginning again to press hard upon the union fields operating on a fixed wage scale. Of this tendency more was to be seen in 1924.

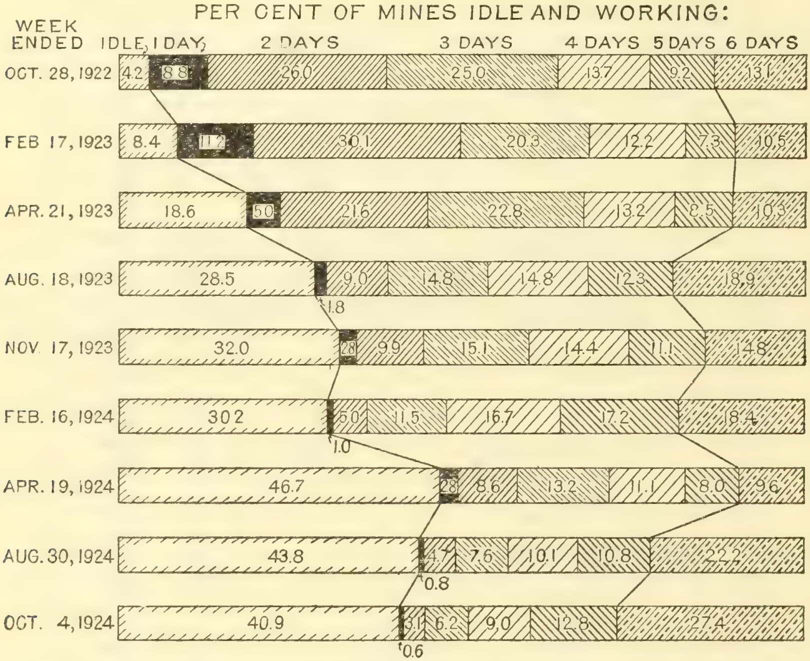

FIGURE 29.—Per cent of idle, part-time, and full-time mines in nine representative weeks, 1922–1924. This chart is based solely on mines reporting weekly to the U. S. Geological Survey, of which there are about 2,500. They represent about one-half the output of the country. Though not complete, the figures show the trend

ANTHRACITE TRADE IN 1923

Labor relations.—In the anthracite industry, on the contrary, the chief events of 1923 centered around labor relations. An appraisal of the merits of the controversy between operators and miners would be out of place in this report, and reference will be made only to those events which immediately affected the supply and demand for the product. The agreement of September, 1922, was felt to be in the nature of an armistice rather than a permanent settlement. It was to run for one year. Months before its expiration the miners presented demands for further increases in wages, the check off, and other modifications of the working conditions. Negotiations for a new contract were opened in the usual way, but little progress was made. On July 27 the joint conference at Atlantic City came to a deadlock, and the negotiations were broken off.

There followed a period of six weeks in which the market was unsettled by the uncertainties as to the possibility of another suspension and the terms on which an agreement would be ultimately reached.

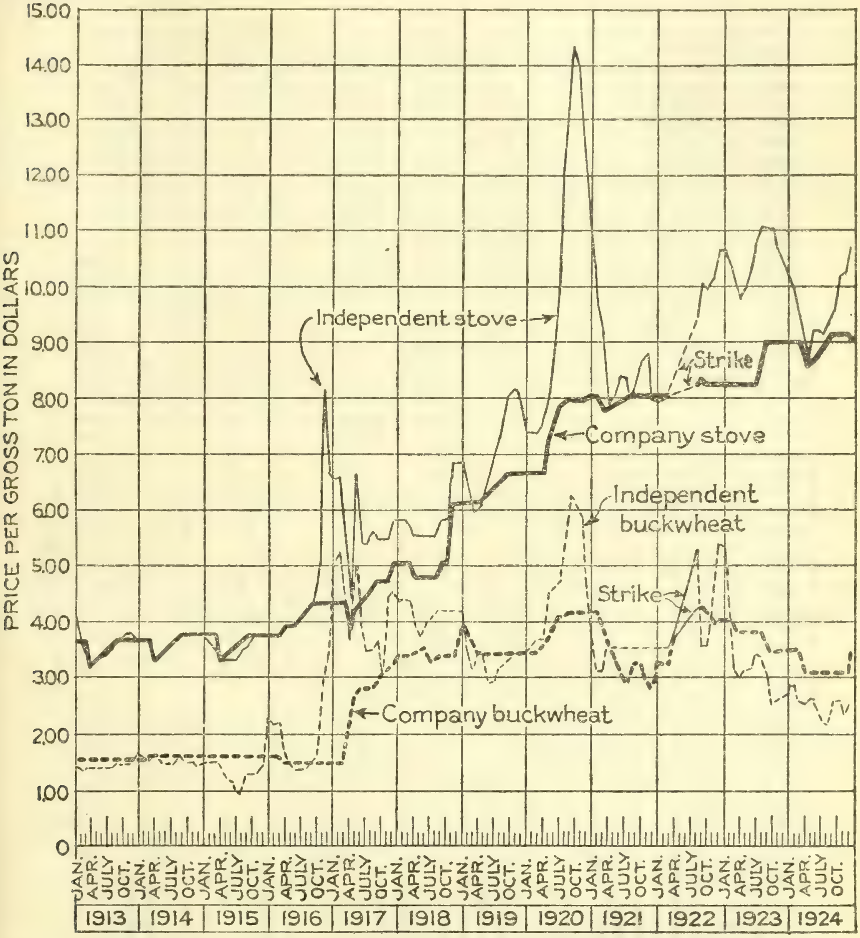

FIGURE 30.—Monthly prices of anthracite f. o. b. mines, 1913–1924, as quoted by Coal Age. The diagram shows in dollars per gross ton the average company prices and average "independent" spot quotations on stove and buckwheat sizes of Pennsylvania anthracite at the mines. Prices shown are averages of the range as quoted on the New York market. Reproduced from Coal Age, by permission

The United States Coal Commission, being without authority to prescribe the terms of settlement, called the two parties together and urged in the public interest that negotiations be resumed under some plan that would keep the mines in operation until an agreement had been reached, if necessary by arbitration. The suggestion of arbitration was accepted by the operators but rejected by the miners.[2]

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[2] See Reports by the Commission to the President concerning Negotiations for Renewal of the Anthracite Wage Agreement: U. S. Coal Comm. Rept., vol. 1, pp. 138–145.

The miners and operators still failing to agree, Governor Pinchot, of Pennsylvania, called them together at Harrisburg on August 27 and after conferring with them suggested a basis of settlement in which the principal points were (*a*) extension of the basic eight-hour day to the group of employees still working a longer day; (*b*) a uniform increase in wages of 10 per cent to all employees; (*c*) denial of the check off of union dues, but granting of the right of the union to have a representative present when the men are paid. Governor Pinchot's terms, with slight modifications, were accepted by the two parties on September 8, and on September 19 work was resumed at the mines after a suspension of 14 days.

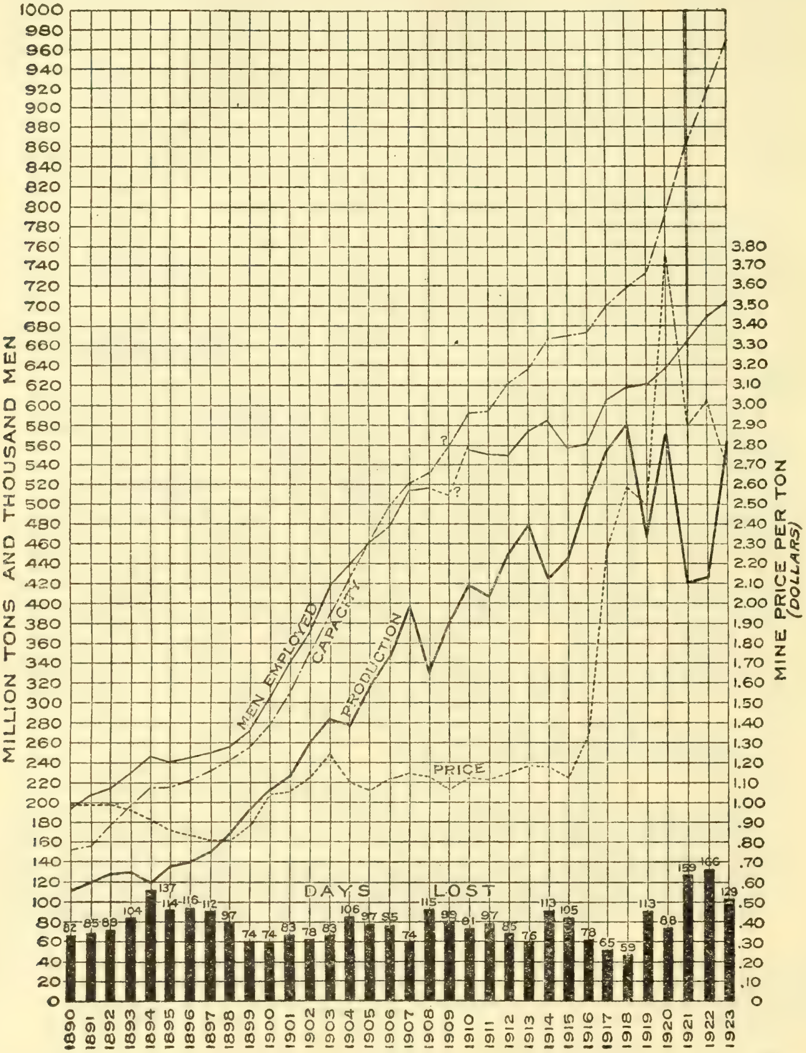

FIGURE 31.—Production, calculated full-time capacity, men employed, mine price per ton, and average number of days lost at bituminous-coal mines, 1890–1923

The anthracite market in 1923.—The course of anthracite prices in 1923 (fig. 30) largely reflects the developments in labor relations. The year opened with independent stove coal selling at premiums of $2 to $3 a ton above the circular prices of the railroad coal companies, a sign of the shortage existing after the strike of 1922. Independent prices dropped in March and April, but by June apprehension over another stoppage caused the market to tighten and independent premiums again to increase. Company prices remained unchanged from September, 1922, to August, 1923, but advances of 75 to 90 cents were made after the wage increase of September 8. The settlement of the wage controversy without prolonged stoppage tended to calm the market, and independent prices were declining by December and were destined to drop still further in 1924.

In sharp contrast to the upward movement of the prices of domestic coal is the downward trend of the steam sizes. Heavy production of the domestic sizes created a surplus of the steam sizes at the same time that prices of bituminous steam coal were falling. Independent buckwheat was selling at a premium in January, but thereafter it plunged below the circular price, and three times during the year the circular itself declined.

GROWTH OF THE INDUSTRY

EARLY RECORDS OF PRODUCTION

The detailed statistics for the year 1923 which are presented in this report can best be understood if attention is first given to a summary of the historical growth of the industry, in which the year 1923 is seen in its relation to the past.

The earliest year of which the Geological Survey has a record of the quantity of coal produced is 1807. The Richmond Basin of Virginia was worked at a much earlier date, and it appears that some coal was dug near Pittsburgh and in the Georges Creek field of Maryland in the eighteenth century, but the statistical history of coal mining on a commercial scale begins in this country with the shipment of anthracite down Lehigh and Susquehanna rivers about 1807. The record by States is given in the table on page 545 for each year from 1807 to 1923.

Up to the Civil War the production of anthracite exceeded that of bituminous coal. Since then the extraordinary increase in the industrial consumption of the country has carried the output of bituminous coal far above that of anthracite. The peak of production of soft coal in 1918 was 5.8 times as great as that of anthracite.

BITUMINOUS-COAL INDUSTRY

The modern history of bituminous coal mining may conveniently be dated from 1890, when the Survey's more complete record of production, men employed, and days worked begins. From that year to 1923 the quantity produced increased fivefold, the value of the product fourteenfold, and the number of employees between three and fourfold. The principal statistical facts of the industry for each year of this 34-year period are shown in Table 4.

The production in 1923, indicated by the heavy black line of Figure 31, has been exceeded but twice in the history of the industry—namely, in 1918 and in 1920. Nevertheless, the output for 1923 fell short of what might have been expected from the rate of growth in the years before the war. The average value of the coal produced in 1923 was less than in any of the three years preceding, though greater than in 1918. The average for 1923 was $2.68 a net ton at the mine, as against $1.18 in 1913; in other words, it was more than twice the pre-war value.

Though the production in 1923 was less, the number of men employed was much greater than in either 1918 or 1920. Between 1920 and 1923 there were added to the pay rolls of the industry 63,000 men. At the same time a remarkable increase occurred in the output per man employed per day. This figure has been steadily rising: In 1890 it was 2.56 tons; in 1920 it stood at 4 tons. This was an increase of 56 per cent in 30 years. From 1920 to 1923 the production per man increased even more rapidly, and in 1923 it stood at 4.47 tons. Probably the chief factor in the increasing output per man is the adoption of machine mining. In 1891, the year of earliest record, 5.3 per cent of the bituminous coal was cut by machine; in 1923 the proportion had risen to 66.9 per cent.

With an increase both in the number of men worked and in the average output per man per day, there was a large increase in the productive capacity of the industry. The best measure of capacity that is available, plotted with the dot and dash line in Figure 31, shows a more rapid increase for the period since the war than before. This increase in productive facilities at a time when the demand for coal was stationary, if not declining, has brought idleness both to the capital and the labor in the mines. The industry has become accustomed to part-time employment, for in the year of first record the number of days worked averaged but 226, leaving 82 possible working days in idleness. But the time lost has been greater since the war than before on account of the increase in productive capacity above noted. The black columns at the base of Figure 31 indicate the amount of lost time in each year. The low point—59 days—was reached in 1918. The high point of 166 days came during the great strike of 1922, when many mines were idle for 5 months or more. Even in 1923, with an output exceeded but twice before, the labor and capital in the industry were idle on the average 129 days and worked on the average 179 days. The time lost on account of strikes in 1923 was 2 days on the average for all men employed, as against 78 days in 1922.

The salient features of 1923 and the years immediately preceding may be summarized in a word. The number of employees and the output per man have been increasing and with them the potential capacity. The demand has been stationary or even declining. The average time worked has therefore been decreasing, and with it prices have tended to fall. The working of these broad tendencies in the several departments of the industry forms the subject of the figures that follow.

TABLE 4.—*Growth of the bituminous coal mining industry, 1890–1923*

Year	Production (millions of net tons)	Value (millions of dollars)	Men employed (thousands)	Calculated capacity [a] (millions of net tons)	Average number of days worked	Average number of days lost on account of—			Value per ton	Tons produced per man per day	Per cent mined by machine
						Strikes	Other causes	Total days lost			
1890	111	110	192	152	226	(b)	(b)	82	$0.99	2.56	(b)
1891	118	117	206	163	223	(b)	(b)	85	.99	2.57	5.3
1892	127	125	213	178	219	(b)	(b)	89	.99	2.72	(b)
1893	128	123	230	194	204	(b)	(b)	104	.96	2.73	(b)
1894	119	108	245	214	171	(b)	(b)	137	.91	2.84	(b)
1895	135	116	240	215	194	(b)	(b)	114	.86	2.90	(b)
1896	138	115	244	221	192	(b)	(b)	116	.83	2.94	11.9
1897	148	120	248	232	196	(b)	(b)	112	.81	3.04	15.3
1898	167	133	256	243	211	(b)	(b)	97	.80	3.09	19.5
1899	193	168	271	254	234	8	66	74	.87	3.05	22.7
1900	212	221	304	279	234	5	69	74	1.04	2.98	24.9
1901	226	236	340	309	225	2	81	83	1.05	2.94	25.6
1902	260	291	370	348	230	7	71	78	1.12	3.06	26.8
1903	283	352	416	387	225	3	80	83	1.24	3.02	27.6
1904	279	306	438	425	202	8	98	106	1.10	3.15	28.2
1905	315	335	461	460	211	2	95	97	1.06	3.24	32.8
1906	343	381	478	496	213	28	67	95	1.11	3.36	34.7
1907	395	451	513	520	234	1	73	74	1.14	3.29	35.1
1908	333	374	516	531	193	11	104	115	1.12	3.34	37.0
1909	380	405	543	560	209	1	98	99	1.07	(b)	37.5
1910	417	469	556	592	217	35	56	91	1.12	3.46	41.7
1911	406	451	550	593	211	2	95	97	1.11	3.50	43.9
1912	450	518	549	622	223	10	75	85	1.15	3.68	46.8
1913	478	565	572	635	232	5	71	76	1.18	3.61	50.7
1914	423	493	584	668	195	19	94	113	1.17	3.71	51.7
1915	443	502	557	672	203	4	101	105	1.13	3.91	55.0
1916	503	665	561	673	230	4	74	78	1.32	3.90	56.5
1917	552	1,249	603	699	243	4	61	65	2.26	3.77	55.5
1918	579	1,492	615	717	249	1	58	59	2.58	3.78	55.9
1919	466	1,161	622	736	195	25	88	113	2.49	3.84	59.2
1920	569	2,130	640	796	220	6	82	88	3.75	4.00	59.8
1921	416	1,200	664	860	149	3	156	159	2.89	4.20	65.6
1922	422	1,275	688	916	142	78	88	166	3.02	4.28	63.2
1923	565	1,515	705	970	179	2	127	129	2.68	4.48	66.9

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[a] Computed by dividing production in tons by the average number of days worked and multiplying the quotient by the theoretical full time, 308 days.

[b] No data.

ANTHRACITE INDUSTRY

A different picture is presented by the historical summary of anthracite mining in Table 5. From 1890 to 1923 the production of anthracite has barely doubled, whereas that of bituminous coal has increased fivefold. The value of the anthracite output, on the other hand, has increased nearly ninefold.

In the number of employees, the figures for which include boys, particularly in the earlier years, the increase has been but 25 per cent from 1890 to 1923. At the same time the output per employee per day has shown no great change. The presence of culm-bank coal in the statistics makes it difficult to interpret the average output per man per day, but the figures as they stand show an increase from 1890 to about 1899, followed by a slight decrease. There has, however, been a notable improvement in the average number of days worked. It stood at 200 in 1890 and at 268 in 1923. This increase in the amount of productive time has come about since 1902, for in the years preceding the great strike of that year the working time, if anything, declined. It is the increase in number of days worked that has made possible a relatively large increase in production with a small increase in number employed.

In the 30 years covered by the table has come a change in the character of the demand for anthracite. In 1890 the then domestic sizes (sizes above pea) constituted 76.9 of the shipments; by 1923 this proportion had dropped to 63.7 per cent. This significant change permitted the recovery by washing of much of the small coal that in earlier years had been thrown upon the culm banks. Shipments from washeries and dredges in 1890 were only 42,000 tons. In 1923 they amounted to 4,000,000 tons.

The most significant fact of the anthracite industry is that production has shown no consistent increase since 1913. In that year 82,000,000 gross tons was produced, practically the same as the output of 1923. The record production of 1917 and 1918 included a large proportion of culm-bank coal.

TABLE 5.—*Growth of the anthracite mining industry, 1890–1923*

Year	Production (millions of gross tons)	Value (millions of dollars)	Employees (thousands)	Average number of days worked	Average days lost on account of strikes	Net tons produced per man per day	Washery and dredge shipments (millions of gross tons)	Per cent of shipments made up of domestic sizes, excluding pea
1890	41	66	126	200	(a)	1.85	(b)	76.9
1891	45	74	126	203	(a)	1.98	0.1	75.7
1892	47	82	129	198	(a)	2.06	.1	76.0
1893	48	86	133	197	(a)	2.06	.2	74.9
1894	46	78	132	190	(a)	2.08	.6	73.7
1895	52	82	143	196	(a)	2.07	1.1	69.9
1896	49	82	149	174	(a)	2.10	.9	70.3
1897	47	79	150	150	(a)	2.34	1.0	68.5
1898	48	75	146	152	(a)	2.41	1.1	67.3
1899	54	88	140	173	(a)	2.50	1.4	66.1
1900	51	86	144	166	24	2.40	2.1	64.7
1901	60	113	145	196	----------	2.37	2.6	64.2
1902	37	76	148	116	96	2.40	2.0	61.0
1903	67	152	150	206	----------	2.41	3.6	63.6
1904	65	139	156	200	—½	2.35	2.8	62.0
1905	69	142	165	215	—½	2.18	2.6	60.9
1906	64	132	162	195	37	2.25	3.8	59.1
1907	76	164	167	220	----------	2.33	4.3	58.6
1908	74	158	124	200	----------	2.39	3.6	59.8
1909	72	149	(a)	205	—½	(a)	3.7	58.3
1910	75	161	169	229	—½	2.17	3.3	58.6
1911	81	175	173	246	—½	2.13	3.2	59.4
1912	75	178	174	231	40	2.10	3.2	60.8
1913	82	195	176	257	3	2.02	2.1	61.7
1914	81	188	180	245	1	2.06	1.7	61.4
1915	79	185	177	230	1	2.19	2.5	60.1
1916	78	202	160	253	6	2.16	3.1	60.5
1917	[c] 89	284	154	285	1	[c] 2.27	5.4	61.0
1918	[c] 88	336	147	293	—½	[c] 2.29	6.6	60.1
1919	79	365	155	266	2	2.14	3.3	64.2
1920	80	434	145	271	13	[c] 2.28	5.0	63.1
1921	81	452	160	271	5	2.09	1.6	66.5
1922	49	274	157	151	125	2.31	3.2	62.9
1923	83	507	158	268	17	2.21	4.1	63.7

[a] No data.

[b] Less than $\frac{1}{10}$ million tons.

[c] Years of heavy washing output.

COMPETITION OF COAL AND OTHER SOURCES OF POWER

Although the productive capacity and labor force of the bituminous coal mines has continued to increase since the war, the consumption has failed to increase, if indeed it has not declined. Because of the serious consequences to the labor and capital engaged in the industry, it is important to measure the rates of growth and to inquire what causes have curtailed the expected demand. The following paragraphs are adapted, with the permission of Coal Age, from a paper by members of the United States Geological Survey.[3]

Since the war the demand for coal has not been growing as fast as before that time, if indeed it is now growing at all.

Anthracite production, as practically everyone knows, has shown no material increase in fresh-mined coal since 1913. Production of bituminous coal, on the contrary, showed a steady growth up to 1918. For the 20 years from the founding of the central competitive field to the end of the war the normal rate of increase of soft-coal output averaged 16,800,000 tons a year. Actual production in a given year might rise above the normal line, or fall below it (fig. 32) (Table 6), depending on the state of general business. In years of depression it dropped below; in boom years it rose above normal; but there is no mistaking the steadiness of the normal increase. It was one of the most characteristic measures of American business activity. The coal industry counted upon this steadily growing demand, and the opening of new mines and steady recruiting of new miners was the industry's means of preparing for a constantly enlarging market.

Since the war, however, the market has ceased to expand, or at best it is expanding at a much slower rate. The largest annual output attained since the armistice was declared was 565,000,000 tons in 1923. That included 26,000,000 tons put into storage, so that the amount actually consumed or exported was only 539,000,000 tons. Had the pre-war rate of expansion continued, the market would have absorbed 614,000,000 tons. Bituminous-coal consumption in 1923, therefore, was 75,000,000 tons less than might have been expected on the basis of pre-war experience.

Table 6.—*Normal production of bituminous coal as calculated by E. E. Day and percentage of normal produced, 1899 to 1923*

Year	Calculated normal (tons)	Percentage of normal produced	Year	Calculated normal (tons)	Percentage of normal produced
1899	208, 000, 000	93	1912	429, 000 000	105
1900	225, 000, 000	94	1913	446, 000, 000	108
1901	242, 000, 000	93	1914	463, 000, 000	92
1902	259, 000, 000	100	1915	480, 000, 000	92
1903	276, 000, 000	102	1916	497, 000, 000	101
1904	293, 000, 000	95	1917	513, 000, 000	108
1905	309, 000, 000	102	1918	530, 000, 000	109
1906	326, 000, 000	105	1919	547, 000, 000	85
1907	343, 000, 000	115	1920	564, 000, 000	101
1908	360, 000, 000	92	1921	581, 000, 000	71
1909	377, 000, 000	101	1922	598, 000, 000	71
1910	394, 000, 000	106	1923	614, 000, 000	92
1911	410, 000, 000	99			

Anyone, of course, might say that this figure of 539,000,000 tons for 1923 is larger than that of any other year except 1917, 1918, and 1920, and that consequently the industry is no worse off than it was, say, in 1916. Such a statement might be true if the industry were one of stationary capacity, as, for example, anthracite mining is. As a matter of fact, however, the capacity of bituminous mines is far from stationary. It has been growing faster since the war than before. In the five years from 1913 to 1918 the full-time productive capacity of the industry increased by 82,000,000 tons. But in the five years after the war, from 1918 to 1923, capacity increased 254,000,000 tons, or just three times as much.

The cause of this great increase of productive facilities lay largely in the high prices of the war period and 1920, but whatever the cause, the combination of arrested demand and rapidly increasing capacity has brought about great distress. A stationary demand may be just as serious to an industry with increasing capacity as a falling demand would be to an industry with stationary capacity. It is therefore most important for the bituminous operator to understand why the expected increase in output has not materialized. There are a number of reasons.

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[3] Tryon, F. G., McKenney, W. F., and Finn, E. E., Relative rate of growth shows further inroads of oil on coal consumption: Coal Age, vol. 27, Jan. 15, 1925.

One reason is that business in general in the United States probably has not increased at quite the same pace as before 1918. Business certainly has grown faster than the demand for coal would indicate, but probably not quite as fast as before. Even America could not escape entirely from the after effects of the war.

Another reason is that the high prices of fuel from 1917 to 1920 stimulated an interest in fuel economy such as was never felt before. The results have been remarkable. Progress in the design of fuel-burning equipment has been matched by more care in firing. It is not possible to say just how many tons of coal have been saved in the aggregate, but there are straws which show the direction of the wind. Beehive coking, which wastes 33 per cent of the heat in the coal, has been largely replaced by the by-product process, which recovers all but 10 per cent. Consumption of railroad fuel per thousand ton-miles has fallen notably. In 1913 it took 2,433 pounds of coke to make a ton of pig iron, whereas in 1922 the work was done with 2,176 pounds. The coal consumption per kilowatt-hour produced by electric utilities dropped from 3.2 pounds in 1919 to 2.4 pounds in 1923, or 25 per cent in five years.

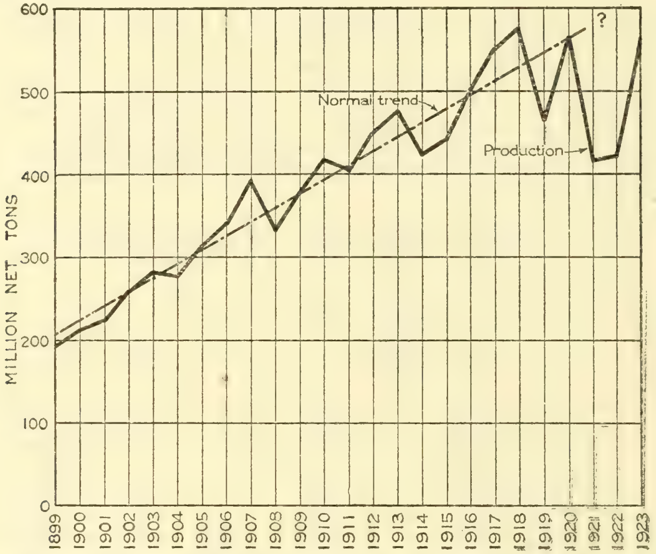

FIGURE 32.—Annual production of bituminous coal and line of normal trend, 1899–1923, as computed by E. E. Day. The normal growth of production from 1899 to 1919 was computed by Professor Day at 16,800,000 tons a year. Since 1919 this rate of increase has not been maintained, chiefly because of the great depression of 1921 and the strike of 1922, but also apparently because the slope of the line of normal growth is changing

Great as have been economies in fuel utilization, however, they are not sufficient to account for all of the slowing up in coal demand. Another cause, and one whose importance the industry has not fully sensed, is competition of other fuels and power sources. It is to this cause that this article is addressed.

There has been much talk recently of the "fuel-oil menace," and various attempts have been made to measure the displacement of coal by fuel oil. We made such an attempt a few years ago and concluded that from April, 1919, to June, 1920, the quantity of coal actually displaced at plants that changed over from coal to fuel oil has been less than 2 per cent of the total consumption of coal. Other observers, considering the years 1922 and 1923, have estimated the actual replacement at about 5 per cent. But this actual replacement at plants that changed over from one fuel to another, even if it could be measured accurately, tells only a part of the story. It does not show the large amount of potential new business which would fall to coal were there not other means of accomplishing the same work which at the moment appeared cheaper.

Gasoline is meeting a demand that otherwise would have fallen to coal, if not directly then indirectly, through the medium of electricity. The world's potential appetite for power and heat would not be less if there were no gasoline. It would merely seek satisfaction in some other way. Coal, though somewhat more costly and less convenient, could largely have satisfied that demand. Consider, for example, the enormous expansion of automotive transportation. Had gasoline not been available, we should have provided not millions of automobiles and thousands of miles of highway, but light railroads and electric traction lines instead. The electric vehicle, whose growth has been arrested by cheap gasoline, would have met a large part of the present requirement for automotive transportation, and its batteries would have been charged with coal-produced energy.

New water-power developments reduce by just so much the potential demand for coal power. This invisible competition between the several sources of power is fully as significant as the visible substitution of fuel oil in a plant originally built to burn coal. The question is really, "Is the country's aggregate demand for power and heat—or 'energy,' to use a single word—falling or rising? How much of that aggregate demand is being met by means of coal? How much by means of fuel oil, gasoline, kerosene, and natural gas? How much by means of falling water?" The problem is largely one of measuring the relative rates of growth of these sources of energy.

Table 7 shows the total supply of energy available in the United States excluding the small amounts furnished by firewood and work animals. To combine water power, oil, and coal it is necessary to have a common denominator. For this purpose the heating value in British thermal units of the fuels will suffice, and in the table the total production of each fuel has been converted into trillions of British thermal units.[4] The figures for oil and gas were courteously furnished by G. B. Richardson, of the Geological Survey. Water power is represented in the table by the British thermal units of fuel which it would have been necessary to burn in order to give the same amount of power. Natural gas, in the early years before the accurate record begins, is represented by the estimated quantity of coal displaced by gas. The table goes back to 1819, to the very beginning of coal mining, in order to show the trend. Up to 1913 every tenth year is shown. Beginning with 1918 the record for each year is given.

TABLE 7.—*Annual supply of energy from mineral fuels and water power, 1819–1923*

[Figures represent trillions of British thermal units, and because of rounding do not always add across exactly. Water power is represented by British thermal unit of coal necessary to produce the same amount of power. Figures represent production, and those for oil imports take no account of changes of stocks]

Year	Anthracite	Bituminous coal	Total coal	Domestic oil	Natural gas	Imported oil	Total oil and gas	Total mineral fuels	Water power [a]	Grand total including water power
1819	(b)	--------	(b)	--------	--------	--------	--------	(b)	(c)	--------
1829	4	3	6	--------	--------	--------	--------	6	(c)	--------
1839	27	41	68	--------	--------	--------	--------	68	(c)	--------
1849	109	64	173	--------	--------	--------	--------	173	(c)	--------
1859	262	158	419	(b)	--------	--------	--------	419	(c)	--------
1869	464	415	879	25	--------	--------	25	904	(c)	--------
1879	822	993	1, 815	119	(b)	--------	119	1, 934	(c)	--------
1889	1, 239	2, 507	3, 746	211	[d] 268	--------	479	4, 225	91	4, 316
1899	1, 643	5, 065	6, 708	342	[d] 240	--------	582	7, 291	135	7, 426
1909	2, 205	9, 949	12, 155	1, 099	517	--------	1, 616	13, 771	411	14, 182
1913	2, 490	12, 535	15, 025	1, 491	626	102	2, 219	17, 243	588	17, 831
1918	2, 688	15, 180	17, 868	2, 136	775	226	3, 137	21, 005	837	21, 842
1919	2, 396	12, 206	14, 602	2, 270	802	317	3, 389	17, 991	892	18, 883
1920	2, 437	14, 899	17, 336	2, 658	858	637	4, 153	21, 489	971	22, 460
1921	2, 461	10, 897	13, 358	2, 833	712	752	4, 297	17, 655	908	18, 563
1922	1, 487	11, 063	12, 551	3, 345	820	764	4, 929	17, 480	1, 024	18, 504
1923 [e]	2, 539	14, 791	17, 330	4, 394	1, 084	492	5, 970	23, 300	1, 136	24, 436

[a] No figures for water power are available prior to 1889. The fuel equivalent for water power is calculated from the reported horsepower of installed water wheels, assuming a capacity factor of 20 per cent for manufactures and mines and of 40 per cent for public utilities, and assuming that the theoretical thermal equivalent of 1 horsepower-hour (2,547 British thermal units) is 7 per cent of the British thermal units that would have been consumed in generating 1 horsepower-hour from fuels in practice. For 1919 to 1923, however, actual reports of the horsepower-hours produced by water in electric utility plants have been used.

[b] Less than 0.5.

[c] No data.

[d] Based on the amount of coal displaced by gas as estimated by the gas companies at the time.

[e] Were allowance made for additions to stocks of coal and oil in 1923, the energy for that year would appear less.

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[4] The unit heat values employed in this calculation are as follows: Anthracite, 13,600 British thermal units per pound; bituminous coal (with due allowance for lignite), 13,100 British thermal units per pound; oil, 6,000,000 British thermal units per barrel; and natural gas, 1,075 British thermal units per cubic foot.

Figures showing trillions of British thermal units are not intelligible to anyone, even to fuel chemists, but their meaning becomes clear in Table 8, which shows the relative rates of growth. If the supply of any one of the competing sources of power in 1918 is expressed by the number 100, then the supply in any other year can be easily expressed as an index number or percentage of the base year, and in this way the rates of growth of the several competitors can be quickly compared.

TABLE 8.—*Relative rates of growth of coal, oil, and water power, 1819–1923*

[The figures for the year 1918 are represented by the number 100, and the figures for all other years are expressed as a percentage of the 1918 rate]

Year	Anthracite	Bituminous coal	Total coal	Domestic oil	Natural gas	Imported oil	Total oil and gas	Total mineral fuels	Water power	Grand total, including water power
1819	(a)	--------	(a)	--------	--------	--------	--------	(a)	(b)	(b)
1829	(a)	(a)	(a)	--------	--------	--------	--------	(a)	(b)	(b)
1839	1	(a)	(a)	--------	--------	--------	--------	(a)	(b)	(b)
1849	4	(a)	1	--------	--------	--------	--------	1	(b)	(b)
1859	10	1	2	(a)	--------	--------	(a)	2	(b)	(b)
1869	17	3	5	1	--------	--------	1	4	(b)	(b)
1879	31	6	10	6	(a)	--------	4	9	(b)	(b)
1889	46	17	21	10	35	--------	15	20	11	20
1899	61	33	37	16	31	--------	19	35	16	34
1909	82	66	68	51	67	(c)	52	66	49	65
1913	93	83	84	70	81	45	71	82	70	82
1918	100	100	100	100	100	100	100	100	100	100
1919	89	80	81	106	103	140	108	86	107	86
1920	91	98	97	124	111	282	132	102	116	103
1921	92	72	74	132	92	333	137	84	109	85
1922	55	73	70	156	106	338	157	83	122	85
1923	94	97	97	205	140	218	191	111	136	112

[a] Less than 0.5. [b] No data for water power. [c] Imports negligible before 1913.

It would be misleading to contrast years like 1919, 1921, or 1922, which were marked by strikes or general business depression, with the prosperous year 1918. Instead let us take 1923, when general business was booming and the coal market was stimulated by the demand for extra tonnage to build up the depleted stocks. In comparison with 1918, the output of anthracite in 1923 had fallen 6 points and is represented by the number 94; the output of bituminous coal had fallen 3 points and is represented by 97.

Contrast this with the change in oil and gas. Production of domestic oil had more than doubled, rising to the index number 205. Natural gas shows a large increase. Imported oil, which has now become a large factor in the energy supply of the country, rose to three times the 1918 rate in 1922, and even in 1923 stood at index number 218. Thus, while the total supply of coal had declined in importance, the total supply of oil and gas had greatly increased. Adding together all the oil and all the gas, their sum in 1923 was 91 per cent above that in 1918.

Even water power has shown a material increase. There is no complete information as to the number of horsepower-hours produced from water, but the best estimates available indicate that they rose from 1918 to 1923 by 30 or 35 per cent.

Now by combining all the sources of power into one index number, we can tell whether the country's total demand for power has been declining. If the total heat units contributed in 1918 by coal, oil, gas, and water power put together are represented by the number 100, then the heat units contributed in 1923 by all these sources are represented by the number 112.

In other words, the total energy consumption of the country instead of falling off in 1923 showed an increase of 12 points over even 1918. As shown by the slope of the curve for total energy in Figure 33, the trend of growth from 1918 to 1923 is a not unnatural prolongation of that before 1918. Remembering that this index represents energy units produced, without regard to the fact that utilization in the meantime has become more efficient, it appears that the country's appetite for power and heat has continued to increase at a rate very close to normal.

An increasing rate of total energy consumption coupled with a decreasing rate of coal production shows very clearly that some other source of energy has been displacing coal. What that other source is will be clearer from Figure 34, which shows the percentage of the total energy supply from mineral fuels that was contributed by each source in the years under consideration.

Thus far we have been speaking of rates of growth without regard to the size of each item. A great increase in a small item may mean little. We have been accustomed to think of oil and gas as a small item in comparison with coal.

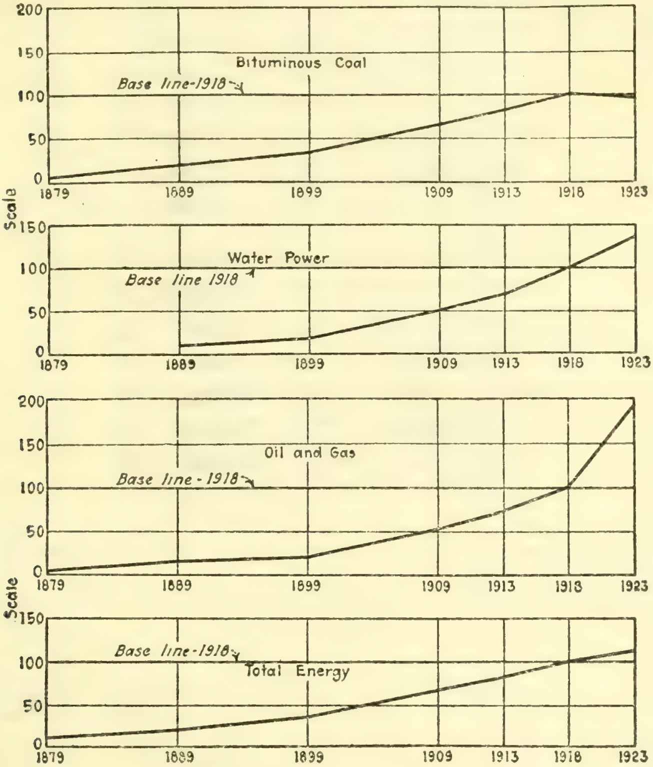

FIGURE 33.—Relative rates of growth of bituminous coal, oil and gas, water power, and total energy, 1879–1923. In recent years oil and gas and water power have enjoyed a rapid rise at the expense of coal. The total energy has not kept up entirely with the trend of earlier years, owing, perhaps, to the greater efficiency in the use of fuel, but the figures are not far from what may be regarded as normal. Coal, however, has taken a downward trend. The diagram makes no allowance for changes in stocks of the fuels during the year; were such allowance made, the figures for 1923 would be smaller

This opinion was perhaps justified in pre-war years, when oil and gas furnished but 10 or 12 per cent of the total energy supply, but it will have to be scrapped now that in 1923 oil and gas had so far increased as to contribute 26 per cent of the total energy from mineral fuels (Table 9). In 1918 oil and gas contributed but 15 per cent of the total energy from fuels. To put it another way: In 1918 the heating value of coal was to the heating value of all oil and gas nearly as 6 is to 1; in 1923 the ratio was as 3 is to 1.

Water power, though it has increased since the war faster than coal, is a small item in comparison with fuel. Its contribution to the energy supply of the country is only 4 or 6 per cent as great as that supplied by fuels. The real competitor of coal therefore is not water power but oil.

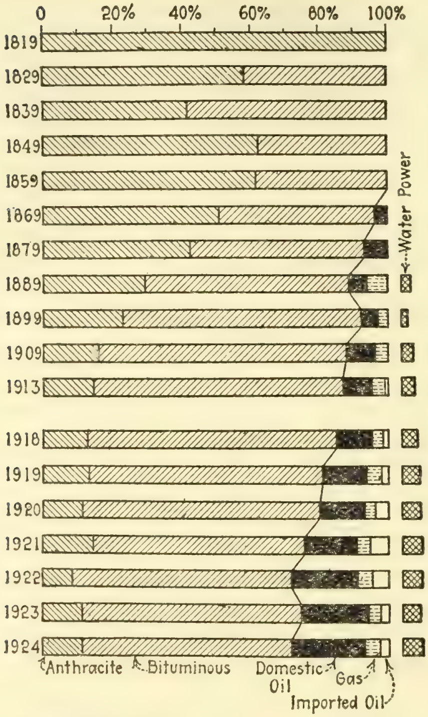

FIGURE 34.—Percentage of total heat value furnished by each mineral fuel, 1819-1924

TABLE 9.—*Percentage of total heating value contributed by the several mineral fuels, 1819–1923*

Year	Anthracite	Bituminous	Total coal	Domestic oil	Natural gas	Imported oil	Total oil and gas	Water power (per cent of fuels)[a]
1819	100.0		100.0					(a)
1829	58.4	41.6	100.0					(a)
1839	40.2	59.8	100.0					(a)
1849	62.8	37.2	100.0					(a)
1859	62.3	37.7	100.0	(b)				(a)
1869	51.3	45.9	97.2	2.8	(b)		2.8	(a)
1879	42.5	51.3	93.8	6.2	(b)		6.2	(a)
1889	29.3	59.3	88.6	5.0	[c]6.4		11.4	2.2
1899	22.5	69.5	92.0	4.7	[c]3.3		8.0	1.9
1909	16.0	72.2	88.2	8.0	3.8	(b)	11.8	3.0
1913	14.4	72.7	87.1	8.7	3.6	0.6	12.9	3.4
1918	12.8	72.3	85.1	10.1	3.7	1.1	14.9	4.0
1919	13.3	67.9	81.2	12.6	4.5	1.7	18.8	5.0
1920	11.4	69.3	80.7	12.4	4.0	2.9	19.3	5.0
1921	14.0	61.7	75.7	16.0	4.0	4.3	24.3	5.1
1922	8.5	63.3	71.8	19.1	4.7	4.4	28.2	5.9
1923	10.9	63.5	74.4	18.9	4.6	2.1	25.6	4.9

[a] No figures for water power prior to 1889 are available. Hence to make the figures comparable, the data for water power thereafter are expressed as percentage of the fuel total but are not included in the base on which the percentage is computed.

[b] Less than 0.1 per cent.

[c] Figures from 1869 to 1899 based on estimated quantity of coal displaced.

METHOD OF COLLECTING THE STATISTICS

VOLUNTARY COOPERATION

The principal statistics for each State during the last three years are given in Table 2 (pp. 501–503). These statistics are obtained from the producers' written reports, most of them signed by officers of the companies that furnish the figures. The reports are collected by correspondence, which is supplemented by visits of field agents if correspondence has failed. The Geological Survey has no power to subpoena records or to compel the filing of reports or to punish producers for rendering false reports.

Under this system accurate results can be obtained only by the generous cooperation of the producers in furnishing returns voluntarily. The operators generally make cordial responses to the Survey's questionnaires, with which they have become familiar through more than 40 years of contact and cooperation, so that a very large percentage of the returns are obtained by mail, leaving relatively few to be obtained by personal visits.

Accurate statistics might not be obtained under a system of voluntary reporting if information was requested which the persons addressed were reluctant to furnish or concerning which they had a motive to misrepresent the facts. No questions of this character are asked by the Survey on its annual report forms, except possibly the questions concerning the value of the product and the occurrence of strikes.

In 1923, as in 1922 and 1920, a number of operators declined to state the value of the coal they sold. The number and the importance of these failures to make returns and the method used by the Survey in estimating the values not reported are explained on page 617. The possible errors in the returns dealing with strikes are discussed in Mineral Resources, 1922, Part II, pages 512–518.

The other questions asked by the Geological Survey in its annual schedule deal with the physical operation of the mines. The operators can obtain no advantage by concealing or misstating these facts, for the facts could be definitely ascertained from other sources. The operators' returns may be checked against the records of the departments of mines in States that commonly publish them and against the records of coal shipped by the railroads, which must agree in the aggregate with the reports made by the operators of coal tendered for shipment. These checks are sufficient to warrant public confidence in the substantial accuracy of the returns, subject to the limitations stated in presenting this report. Whether the voluntary system of reporting may be safely used as to inquiries concerning costs, prices, profits, and other financial matters is a different question. The Geological Survey has found it difficult, for example, to reconcile the statements of car supply voluntarily furnished by the railroads with the statements of time shut down for lack of cars voluntarily furnished by the mines, and it is aware that the current reports on time worked and lost by the mines published in its weekly coal statement contain very serious errors.

COMPLETENESS OF THE RETURNS

A complete count of the thousands of wagon mines and country coal banks from which bituminous coal is dug in this country could be made only by sending agents up every creek and along every hillside in the coal-bearing regions. The cost of such a count would prohibit it, and in practice a limit must be set to the size of the mines to be considered. The Federal Census Bureau sets this limit at mines producing about 1,000 tons a year. Many of the States that publish statistics set the limit higher. The Pennsylvania Department of Mines, for example, covers only enterprises employing as many as 10 men.

The Geological Survey desires to ascertain the total output of coal from all sources, large or small, in order to find the rate at which the country's resources are being drawn upon. In practice, however, it has been found advisable to employ different methods for the commercial mines, on the one hand, and the country banks and wagon mines, on the other.

For the commercial mines statistics can be obtained largely by correspondence. To the mailing list new names are constantly being added from the trade journals, from the records of State mine inspectors, from reports of field agents, and from reports by the producers themselves. At intervals the list is checked against lists kept by associations of operators or State officials and lists of shippers kept by railroad-car distributors. Every tenth year the list is further supplemented by the enumerators of the Federal Census Bureau, who canvass the entire country. In 1923 many new names were obtained from the field agents of the Federal fuel distributor and from the United States Coal Commission. Even after all this checking the list is not absolutely complete, but it is very nearly so.

Schedules of inquiry are mailed by the Geological Survey to all producing companies listed, and no company is dropped from the list until it has been definitely accounted for. To follow up companies from which no reply is received by correspondence, cooperative arrangements have been made with State geologists and coal-mine inspectors, field representatives of the United States Bureau of Mines, secretaries of operators' associations, and other local agents, who make inquiry in person and report to Washington. In the Rocky Mountain States the work of following up the returns is now done by the branch offices maintained by the Geological Survey at Denver, Salt Lake City, and San Francisco. Areas to which no permanent local representative of the Survey has been assigned can be covered only by sending out a field agent from Washington, and the present plans include regular work by such agents every year.

Some of the smaller mines are operated so intermittently that the owners can not be found at the end of the year, and recourse must be had to railroads to find the number of tons of coal shipped by these mines, from which estimates of the number of men employed and the value of the product can be made. Such estimates are made in order to round out totals, but only when the evidence shows that a mine was in operation during the year and when all other means of getting the exact figures have failed. Wherever in this report the inclusion of estimates introduces the probability of significant error, that fact is indicated.

The method just described is used in the canvass of commercial producers, including mines that make an output of at least 1,000 tons a year and that are operated rather steadily year after year. To handle the numerous sporadic wagon mines is a different problem and requires a different method. For several years the Geological Survey attempted to canvass these "small mines" also by mail, but the results were found not to be satisfactory. The Survey in 1920 and again in 1922 therefore turned to the railroads and asked for lists of all wagon mines that had shipped coal during the year, the date that each opened and closed, and the number of carloads shipped by each. The response of the railroads was instant and generous. The experiment showed that the only means of obtaining an adequate picture of the activities of wagon mines in a year of high prices is the records of the railroads.

In 1921, however, it was not considered worth while to ask the railroads for this information, because the profound depression in the coal market put the wagon mines temporarily out of business. For this reason, the statistics of production in 1921 do not include the output of wagon mines.

In 1923 market conditions in the early part of the year favored the operation of wagon mines, and the Survey again obtained from the railroads the names of all wagon mines that shipped coal over their lines and the quantity shipped. The total number of mines thus reported by the railroads, eliminating names already on the Survey's list of commercial producers, was 2,384, and their total shipments in 1923 were 1,141,000 tons.

These methods are believed to yield practically complete returns for all mines, big and little, that ship by rail or water and for all those of commercial size that serve a purely local market. No attempt was made in 1923 to measure the product of country coal banks that did not ship by rail. Although the number of such banks runs into the thousands, their combined output is so small as to be negligible. Their product is sold locally, it does not involve the use of railroad cars, and it does not enter into competition with the output of commercial mines. When formerly the Geological Survey attempted to cover these producers regularly, the maximum output reported for them was about 1,000,000 tons a year.

No reports as to number of employees or time worked have ever been obtained from the wagon mines, and all the statistics of number of men employed, average days worked, and the like in this report are calculated from the returns of the commercial mines alone.

UNITS OF MEASUREMENT

The standard unit of measurement adopted for this report is the net or short ton of 2,000 pounds, but as Pennsylvania anthracite is mined and sold by the gross or long ton of 2,240 pounds, that unit is used in the part of the report dealing with anthracite. Unless the unit is otherwise expressly stated, the word "ton" as here used means the net ton of 2,000 pounds, to which all other figures, however reported, have been reduced.

There is a steadily growing sentiment in favor of the general use of the net ton of 2,000 pounds as the standard unit of the coal trade, particularly for bituminous coal in the Eastern States, where both gross and net tons are now used. The use of both units is of course undesirable, but as many State and municipal laws require the use of the gross ton, and as freight rates throughout a part of the Eastern States are now fixed accordingly, it is difficult to make an immediate change to a standard unit. In reports on foreign trade and shipping rates quantities are expressed in either gross or metric tons, and here too the use of more than one unit is undesirable. The general use of the net ton in the United States, even in the anthracite region, is here recommended.

STATISTICS OF PRODUCTION

SUMMARY

The complete returns for 1923 indicate a production of 564,564,662 tons of bituminous coal and lignite, and 93,339,009 tons of anthracite, a total of 657,903,671 tons. The total value at the mines was slightly over $2,000,000,000, of which roughly one-fourth was contributed by anthracite and three-fourths by soft coal. The value for soft coal, $1,515,000,000, has been exceeded but once, and that for anthracite, $507,000,000, is the largest on record.

TABLE 10.—*Coal produced, 1922–23*

Production

	1922		1923	
	Net tons	Value	Net tons	Value
Bituminous coal and lignite	422, 268, 099	$1, 274, 820, 000	564, 564, 662	$1, 514, 621, 000
Anthracite	54, 683, 022	273, 700, 000	93, 339, 009	506, 787, 000
	476, 951, 121	1, 548, 520, 000	657, 903, 671	2, 021, 408, 000

Increase, 1923

	Quantity		Value	
	Net tons	Per cent	Dollars	Per cent
Bituminous coal and lignite	142, 296, 563	33. 7	239, 801, 000	18. 8
Anthracite	38, 655, 987	70. 7	233, 087, 000	85. 2
	180, 952, 550	37. 9	472, 888, 000	30. 5

TABLE 11.—*Coal produced, 1920–1923, by States, and increase or decrease in 1923*

State	1920		1921 [a]		1922		1923		Increase or decrease, 1923			
									Quantity		Value	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Per cent	Dollars	Per cent
Alabama	16, 294, 099	$59, 410, 000	12, 568, 899	$38, 713, 000	18, 324, 740	$42, 856, 000	20, 457, 649	$51, 624, 000	+2, 132, 909	+11. 6	+8, 768, 000	+20. 5
Arkansas	2, 103, 596	9, 592, 000	1, 227, 777	5, 360, 000	1, 110, 046	4, 592, 000	1, 296, 892	5, 192, 000	+186, 846	+16. 8	+600, 000	+13. 1
California, Alaska, Idaho, and Oregon	84, 581	461, 000	115, 662	677, 000	106, 168	535, 000	139, 892	834, 000	+33, 724	+31. 8	+299, 000	+55. 9
Colorado	12, 278, 225	42, 829, 000	9, 122, 760	32, 377, 000	10, 019, 597	31, 701, 000	10, 346, 218	33, 299, 000	+326, 621	+3. 3	+1, 598, 000	+5. 0
Georgia	50, 156	251, 000	33, 815	171, 000	60, 636	246, 000	75, 620	327, 000	+14, 984	+24. 7	+81, 000	+32. 9
Illinois	88, 724, 893	273, 509, 000	69, 602, 763	190, 986, 000	58, 467, 736	168, 925, 000	79, 310, 075	198, 388, 000	+20, 842, 339	+35. 6	+29, 463, 000	+17. 4
Indiana	29, 350, 585	92, 867, 000	20, 319, 509	52, 269, 000	19, 132, 889	54, 524, 000	26, 229, 099	65, 046, 000	+7, 096, 210	+37. 1	+10, 522, 000	+19. 3
Iowa	7, 813, 916	30, 794, 000	4, 531, 392	17, 256, 800	4, 335, 161	16, 119, 000	5, 710, 735	20, 517, 000	+1, 375, 574	+31. 7	+4, 398, 000	+27. 3
Kansas	5, 926, 408	22, 923, 000	3, 466, 641	13, 333, 300	2, 955, 170	10, 816, 000	4, 443, 149	14, 275, 000	+1, 487, 979	+50. 4	+3, 459, 000	+32. 0
Kentucky	35, 690, 762	146, 576, 000	31, 588, 270	85, 092, 600	42, 134, 175	127, 037, 000	44, 777, 317	113, 542, 000	+2, 643, 142	+6. 3	−13, 495, 000	−10. 6
Maryland	4, 065, 239	18, 815, 000	1, 827, 740	6, 602, 000	1, 222, 707	4, 122, 000	2, 285, 926	6, 911, 000	+1, 063, 219	+87. 0	+2, 789, 000	+67. 7
Michigan	1, 489, 765	7, 346, 000	1, 141, 715	5, 555, 000	929, 390	4, 693, 000	1, 172, 075	5, 545, 000	+242, 685	+26. 1	+852, 000	+18. 2
Missouri	5, 369, 565	22, 230, 000	3, 551, 621	13, 915, 500	2, 924, 750	11, 153, 000	3, 403, 151	11, 575, 000	+478, 401	+16. 4	+422, 000	+3. 8
Montana	4, 413, 866	13, 923, 000	2, 733, 958	8, 921, 600	2, 572, 221	8, 208, 500	3, 147, 678	9, 652, 000	+575, 457	+22. 4	+1, 443, 500	+17. 6
New Mexico	3, 683, 440	13, 568, 000	2, 453, 482	9, 585, 000	3, 147, 173	10, 977, 000	2, 915, 173	10, 668, 000	−232, 000	−7. 4	−309, 000	−2. 8
North Carolina	11, 540	81, 000	23, 438	135, 000	78, 570	388, 000	36, 019	132, 000	−42, 551	−54. 2	−256, 000	−66. 0
North Dakota	948, 625	2, 724, 000	864, 903	2, 329, 500	1, 327, 564	3, 513, 000	1, 385, 400	3, 275, 000	+57, 836	+4. 4	−238, 000	−6. 8
Ohio	45, 878, 191	175, 081, 000	31, 942, 776	84, 686, 500	26, 953, 791	87, 056, 000	40, 546, 443	98, 610, 000	+13, 592, 652	+50. 4	+11, 554, 000	+13. 3
Oklahoma	4, 849, 288	23, 294, 000	3, 362, 623	15, 546, 000	2, 802, 511	11, 527, 000	2, 885, 038	10, 874, 000	+82, 527	+2. 9	−653, 000	−5. 7
Pennsylvania (bituminous)	170, 607, 847	642, 630, 000	116, 013, 942	322, 538, 300	113, 148, 308	351, 777, 000	171, 879, 913	472, 217, 000	+58, 731, 605	+51. 9	+120, 440, 000	+34. 2
South Dakota	12, 777	46, 000	7, 553	21, 200	7, 752	22, 000	10, 379	25, 000	+2, 627	+33. 9	+3, 000	+13. 7
Tennessee	6, 662, 428	26, 778, 000	4, 460, 326	14, 932, 000	4, 876, 774	14, 096, 000	6, 040, 268	16, 515, 000	+1, 163, 491	+23. 9	+2, 419, 000	+17. 2
Texas	1, 615, 015	6, 062, 000	972, 839	2, 563, 600	1, 106, 007	2, 563, 000	1, 187, 329	2, 162, 000	+81, 322	+7. 4	−401, 000	−15. 6
Utah	6, 005, 199	19, 350, 000	4, 078, 784	13, 662, 000	4, 992, 008	15, 687, 500	4, 720, 217	13, 657, 000	−271, 791	−5. 4	−2, 030, 500	−12. 9
Virginia	11, 378, 606	45, 446, 000	7, 492, 378	22, 947, 700	10, 491, 174	27, 083, 000	11, 761, 643	32, 468, 000	+1, 270, 469	+12. 1	+5, 385, 000	+19. 9
Washington	3, 757, 093	14, 560, 000	2, 428, 722	9, 787, 000	2, 581, 165	10, 279, 000	2, 926, 392	10, 894, 000	+345, 227	+13. 4	+615, 000	+6. 0
West Virginia	89, 970, 707	390, 046, 000	72, 786, 996	206, 661, 500	80, 488, 192	236, 162, 000	107, 899, 941	285, 481, 000	+27, 411, 749	+34. 1	+49, 319, 000	+20. 9
Wyoming	9, 630, 271	28, 741, 000	7, 200, 666	23, 358, 500	5, 971, 724	18, 162, 000	7, 575, 031	20, 916, 000	+1, 603, 307	+26. 8	+2, 754, 000	+15. 2
Total bituminous	568, 666, 683	2, 129, 933, 000	415, 921, 950	1, 199, 983, 600	422, 268, 099	1, 274, 820, 000	564, 564, 662	1, 514, 621, 000	+142, 296, 563	+33. 7	+239, 801, 000	+18. 8
Pennsylvania anthracite	89, 598, 249	434, 252, 000	90, 473, 451	452, 305, 000	54, 683, 022	273, 700, 000	93, 339, 009	506, 787, 000	+38, 655, 987	+70. 7	+233, 087, 000	+85. 2
Grand total	658, 264, 932	2, 564, 185, 000	506, 395, 401	1, 652, 288, 600	476, 951, 121	1, 548, 520, 000	657, 903, 671	2, 021, 408, 000	+180, 952, 550	+37. 9	+472, 888, 000	+30. 5

[a] Exclusive of wagon mines.

In comparison with 1922, both branches of the industry show an increase in both quantity and value of product, not because the output in 1923 was large so much as because the output in 1922 was curtailed by the great strike.

A better standard of comparison is afforded by 1920, a year of active production. Against that standard the output of 1923 shows a small increase for anthracite and a very slight decrease for bituminous coal. The decrease was not uniform, however, for in some States substantial advances over 1920 were recorded. (See Table 12.) The increase was most apparent in the nonunion fields of the South. Thus Kentucky, including some union and some nonunion territory, produced 25.4 per cent more coal in 1923 than in 1920. For West Virginia the advance was 19.9 per cent and for Virginia 3.4 per cent. In comparison with 1920 the output of Alabama in 1923 shows an advance of 25.6 per cent, but this comparison is misleading because in 1920 the output of the State was curtailed by a strike. From the output in 1918, a fairer standard of comparison, Alabama showed an increase of 6.6 per cent for 1923. Pennsylvania reported little change from 1920. Illinois and Indiana, on the contrary, both showed decreases of 10.6 per cent. In Ohio the output declined 11.6 per cent. The sharpest decline, however, was registered by the trans-Mississippi States. The States of the Great Plains, as a group, from the Dakotas south to Texas, showed a decline of 30.5 per cent; the Mountain States, 20.3 per cent; and Washington, the sole important producer on the Pacific coast, 22.1 per cent. Mention should be made, however, of the exceptional advance of North Dakota, which in 1923 produced 46 per cent more than in 1920. In fact, this State shows a greater increase since 1913 than any other. The decline in Oklahoma, Arkansas, and Missouri was particularly sharp, partly because of the competition of fuel oil. Oklahoma registered a drop of 40.5 per cent, and Arkansas 38.3 per cent. The sharpest decrease of all, however, was recorded by Maryland (43.8 per cent), where the strike of 1922 hung over for many months into 1923.

TABLE 12.—*Bituminous coal produced in 1913, 1920, and 1923*

State	Net tons			Increase or decrease (per cent)	
	1913	1920	1923	1920 to 1923	1913 to 1923
Alabama	17,678,522	[a] 19,184,962	20,457,649	[a]+6.6	+15.7
Arkansas	2,234,107	2,103,596	1,296,892	−38.3	−42.0
Colorado	9,232,510	12,278,225	10,346,218	−15.7	+12.0
Georgia	255,626	50,156	75,620	+50.8	−70.4
Illinois	61,618,744	88,724,893	79,310,075	−10.6	+28.7
Indiana	17,165,671	29,350,585	26,229,099	−10.6	+52.8
Iowa	7,525,936	7,813,916	5,710,735	−26.9	−24.1
Kansas	7,202,210	5,926,408	4,443,149	−25.0	−38.3
Kentucky	19,616,600	35,690,762	44,777,317	+25.4	+128.3
Maryland	4,779,839	4,065,239	2,285,926	−43.8	−52.2
Michigan	1,231,786	1,489,765	1,172,075	−21.3	−4.8
Missouri	4,318,125	5,369,565	3,403,151	−36.6	−21.2
Montana	3,240,973	4,413,866	3,147,678	−28.7	−2.9
New Mexico	3,708,806	3,683,440	2,915,173	−20.9	−21.4
North Dakota	495,320	948,625	1,385,400	+46.0	+179.7
Ohio	36,200,527	45,878,191	40,546,443	−11.6	+12.0
Oklahoma	4,165,770	4,849,288	2,885,038	−40.5	−30.8
Pennsylvania	173,781,217	170,607,847	171,879,913	+0.7	−1.1
South Dakota	10,540	12,777	10,379	−18.8	−1.5
Tennessee	6,860,184	6,662,428	6,040,268	−9.3	−11.9
Texas	2,429,144	1,615,015	1,187,329	−26.5	−51.1
Utah	3,254,828	6,005,199	4,720,217	−21.4	+45.0
Virginia	8,828,068	11,378,606	11,761,643	+3.4	+33.2
Washington	3,877,891	3,757,093	2,926,392	−22.1	−24.5
West Virginia	71,254,136	89,970,707	107,899,941	+19.9	+51.4
Wyoming	7,393,066	9,630,271	7,575,031	−21.3	+2.5
Other States	75,151	96,121	175,911	+83.0	+134.1
	478,435,297	[b] 568,666,683	564,564,662	−.7	+18.0

[a] Production in 1918; used for comparison because Alabama was affected by a strike in 1920.
[b] Total for 1920. The column does not add because of the substitution of the 1918 figure for Alabama.

The changes from 1920 to 1923 become clearer still when the States are grouped into broad producing areas, as shown in Table 13.

TABLE 13.—*Bituminous coal produced in 1913, 1920, and 1923, by groups of States* [a]

Group	Net tons			Increase or decrease (per cent)	
	1913	1920	1923	1920 to 1923	1913 to 1923
Pennsylvania, Maryland, West Virginia, and Virginia	258,643,000	276,022,000	293,827,000	+6.5	+13.6
Eastern Kentucky, Ohio, and Michigan	48,532,000	71,982,000	75,529,000	+4.9	+55.6
Tennessee	6,860,000	6,662,000	6,040,000	−9.3	−12.0
Alabama	17,679,000	[b]19,185,000	20,458,000	[b]+6.6	+15.7
Illinois, Indiana, and Western Kentucky	87,303,000	129,152,000	116,446,000	−9.8	+33.4
North Dakota, South Dakota, Iowa, Missouri, Kansas, Oklahoma, Arkansas, and Texas	28,381,000	28,639,000	20,322,000	−29.0	−28.4
Colorado, Montana, Wyoming, Utah, and New Mexico	26,830,000	36,011,000	28,704,000	−20.3	+7.0
Washington	3,878,000	3,757,000	2,926,000	−22.1	−24.5

[a] Does not include production in Alaska, California, Georgia, Idaho, Nevada, North Carolina, and Oregon.
[b] Production in 1918 used for comparison because Alabama was affected by a strike in 1920.

YEARS OF RECORD PRODUCTION

Although 1923 failed to establish a new record in output for the country as a whole, there were a number of States that established new high marks that year. Conspicuous among them were the nonunion States of the middle and southern Appalachians—Alabama, Virginia, West Virginia, and Kentucky. Alaska also set a new mark, and North Dakota continued its rapid growth. This State had reached a new maximum in 1922 in spite of the strike and pushed its output still higher in 1923. Of the other important producing States the greater number reached their maximum performance in 1920 or in the war years 1917 and 1918. Certain of the older districts, however, have been declining in recent years, and to find the year of highest output for Tennessee it is necessary to go back to 1910; for Michigan, Maryland, and Arkansas to 1907; for Texas to 1913; and for Georgia to 1903. The group including California, Idaho, and Oregon reached its highest level in 1880.

TABLE 14.—*Coal produced in 1923, by States, and highest recorded production*

State	1923 (net tons)	Maximum production	
		Year	Net tons
Alabama	20,457,649	1923	20,457,649
Alaska	119,826	1923	119,826
Arkansas	1,296,892	1907	2,670,438
California, Idaho, and Oregon	20,066	1880	280,155
Colorado	10,346,218	1917	12,483,336
Georgia	75,620	1903	416,951
Illinois	79,310,075	1918	89,291,105
Indiana	26,229,099	1918	30,678,634
Iowa	5,710,735	1917	8,965,830
Kansas	4,443,149	1918	7,561,947
Kentucky	44,777,317	1923	44,777,317
Maryland	2,285,926	1907	5,532,628
Michigan	1,172,075	1907	2,035,858
Missouri	3,403,151	1917	5,670,549
Montana	3,147,678	1918	4,532,505
New Mexico	2,915,173	1918	4,023,239
North Carolina	36,019	1922	78,570
North Dakota	1,385,400	1923	1,385,400
Ohio	40,546,443	1920	45,878,191
Oklahoma	2,885,038	1920	4,849,288
Pennsylvania (bituminous)	171,879,913	1918	178,550,741
South Dakota	10,379	1919	14,417
Tennessee	6,040,268	1910	7,121,380
Texas	1,187,329	1913	2,429,144
Utah	4,720,217	1920	6,005,199
Virginia	11,761,643	1923	11,761,643
Washington	2,926,392	1918	4,082,212
West Virginia	107,899,941	1923	107,899,941
Wyoming	7,575,031	1920	9,630,271
Pennsylvania (anthracite)	93,339,009	1917	99,611,811

RANK OF STATES

Pennsylvania remains easily the leading producer of bituminous coal. Indeed, if the output of anthracite is included, the State produces more coal than its three nearest rivals put together.

In 1923 West Virginia was easily second, though in 1918 it had been closely pressed by Illinois. Illinois retains its position as third in rank. But while there has been no shift among the three leading producers, among the other States that mine large tonnages there have been numerous changes in rank within the last 10 years, as shown by Figure 35. Ohio, easily the fourth in 1913 and 1918, has now dropped to fifth place. Kentucky's extremely rapid growth has carried it to fourth place in Ohio's stead.

A notable feature of the diagram is the general loss in relative standing of the States of the Western Interior field. Iowa dropped from tenth to twelfth place in the 10 years, Kansas from twelfth to fourteenth, Missouri from fourteenth to fifteenth. It is, perhaps, significant that these States are strongholds of unionism and have had to pay both high day rates and high tonnage scales. But the relative cost of union and nonunion labor is not the only factor involved in the shift, for union Indiana changed places with nonunion Alabama in this period of 10 years. Colorado, where the hold of unionism has never been as strong as in many other States, lost in relative standing, and Wyoming, which is completely organized, on the contrary, advanced. Other States whose relative standing improved were Virginia, Tennessee, and Utah.

In Table 11 is presented for convenient reference the output for each State in each of the last four years.

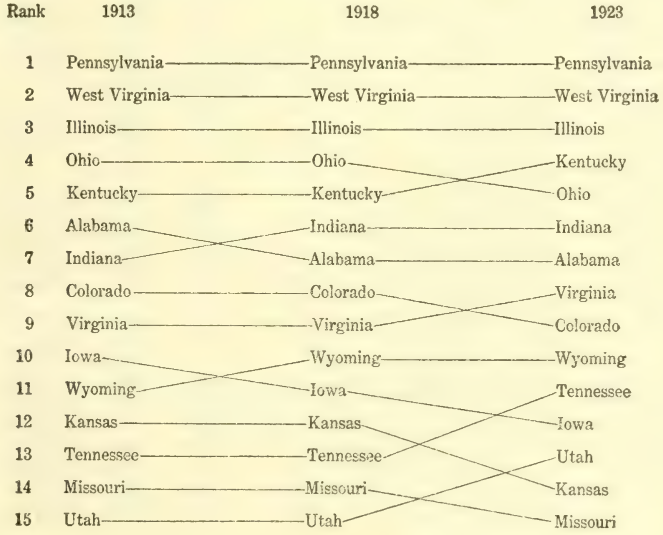

FIGURE 35.—Rank of principal States in production of bituminous coal in 1913, 1918, and 1923

PRODUCTION BY FIELDS

The Geological Survey receives many requests for information on production by trade fields as distinct from States and counties. At the request of the United States Coal Commission the Survey retabulated its records for 1920 and 1921 according to the 92 fields into which the commission divided the bituminous coal mines. The results are shown in Table 15.

The commission's grouping of the fields was made under the direction of C. E. Lesher and R. A. Walter, primarily with a view to its studies of cost of production. The fields are accurately delimited by metes and bounds on pages 2034–2052 of its report. Because all the fields adopted did not coincide with generally accepted trade districts they were designated by number rather than by name. For the convenience of the reader of Table 15, however, the trade name most nearly corresponding to the boundaries established by the commission is also listed.

TABLE 15.—*Bituminous coal produced in the several fields adopted by the United States Coal Commission, 1920–21* [a]

[Exclusive in both years of product of country coal banks and wagon mines shipping by rail]

No.	State	General name of field	Number of mines		Tons produced [b]	
			1920	1921	1920	1921
1	Pennsylvania	Pittsburgh	358	356	38, 245, 000	25, 552, 000
2	do	Connellsville	326	256	34, 095, 000	22, 460, 000
3	do	Westmoreland-Ligonier	164	135	16, 107, 000	11, 735, 000
4a	do	Freeport—Thin	77	79	3, 852, 000	1, 980, 000
4b	do	Freeport—Thick	19	19	5, 574, 000	4, 748, 000
5	do	Butler—Mercer	97	83	2, 168, 000	1, 667, 000
6	do	Blossburg	22	19	768, 000	446, 000
7	do	Broad Top	57	58	1, 678, 000	839, 000
8	do	Somerset	215	200	7, 433, 000	5, 840, 000
9a	do	Central Penn., western	135	130	3, 170, 000	2, 204, 000
9b	do	Central Penn., middle	218	188	15, 511, 000	8, 047, 000
9c	do	Central Penn., eastern	1, 004	873	39, 457, 000	30, 537, 000
10	Maryland-West Virginia.	Maryland-Potomac	157	134	6, 243, 000	2, 993, 000
11	West Virginia	Fairmont	255	224	15, 571, 000	12, 549, 000
12	Ohio-West Virginia.	Panhandle Pittsburgh No. 8	222	201	21, 128, 000	19, 849, 000
13	do	Pomeroy	44	35	1, 732, 000	1, 001, 000
14	West Virginia	Putnam County	12	10	339, 000	291, 000
15	West Virginia-Kentucky.	Kenova	26	25	528, 000	714, 000
16	do	Thacker	84	75	4, 308, 000	3, 483, 000
17	West Virginia	Tug River	62	74	4, 115, 000	4, 343, 000
18	West Virginia-Virginia.	Pocahontas	108	102	16, 290, 000	13, 414, 000
19	West Virginia	Winding Gulf	67	67	5, 615, 000	5, 712, 000
20	do	New River	126	122	7, 582, 000	5, 553, 000
21	do	Kanawha	246	217	12, 724, 000	8, 528, 000
22	do	Coal River	19	17	1, 108, 000	853, 000
23	do	Logan	136	133	10, 092, 000	10, 770, 000
24a	do	Coal and Coke	35	24	804, 000	700, 000
24b	do	Preston County	56	43	1, 854, 000	676, 000
24c	do	Taylor County, Junior, Phillippi, and Gauley.	164	124	5, 558, 000	2, 973, 000
25	Virginia	Southwestern Virginia	107	71	7, 835, 000	4, 480, 000
26	do	Clinch Valley	23	23	2, 349, 000	2, 100, 000
27	do	Upper New River	7	6	164, 000	85, 000
28	do	Richmond Basin	--------	1	------------	4, 000
29	Ohio	Massillon-Palmyra-Lisbon	127	103	2, 823, 000	1, 761, 000
30	do	Coshocton-Goshen	199	149	4, 425, 000	2, 538, 000
31	do	Cambridge	57	56	4, 964, 000	3, 903, 000
32	do	Crooksville	69	53	1, 537, 000	542, 000
33	do	Hocking	248	204	11, 478, 000	6, 072, 000
34	do	Jackson and Ironton	116	70	1, 741, 000	415, 000
36	Kentucky	Northeastern Kentucky	194	181	7, 828, 000	5, 189, 000
37	do	Hazard	108	105	3, 973, 000	5, 190, 000
38	do	Harlan	70	63	5, 062, 000	6, 894, 000
39	Kentucky-Tennessee.	Southern Appalachian	229	162	6, 746, 000	4, 865, 000
40	do	Jellico	66	42	1, 167, 000	797, 000
41	Kentucky	Western Kentucky	185	164	11, 037, 000	8, 618, 000
42	Tennessee	Rockwood-Soddy	71	60	2, 689, 000	1, 728, 000
43	do	Fentress	10	11	800, 000	551, 000
44	Alabama	Big Seam Group	43	42	4, 614, 000	3, 358, 000
45	do	Cahaba Group	84	80	4, 455, 000	3, 729, 000
46	do	Pratt Group	118	111	6, 998, 000	5, 412, 000
47	Indiana	Indiana	301	265	28, 720, 000	20, 063, 000
48	do	Brazil Block	18	12	373, 000	254, 000
49	Illinois	Northern Illinois	47	75	3, 329, 000	2, 139, 000
50	do	Fulton-Peoria	97	168	5, 260, 000	3, 409, 000
51	do	Danville	33	46	3, 968, 000	3, 040, 000
52	do	Central Illinois	100	117	29, 740, 000	20, 788, 000
53	do	Belleville	110	112	12, 956, 000	10, 631, 000
54	do	Murphysboro	7	7	241, 000	270, 000
55	do	Southern Illinois	127	147	33, 155, 000	29, 327, 000
56	Michigan	Michigan	14	14	1, 489, 000	1, 142, 000
57	Arkansas	Sebastian	68	48	1, 693, 000	945, 000
58	do	Excelsior-Logan	18	19	153, 000	154, 000
59	do	Arkansas-Anthracite	10	10	211, 000	127, 000
60	Colorado	Colorado Domestic	102	122	5, 377, 000	4, 204, 000

[a] See text for explanation of fields.

[b] A discrepancy will be found between the total of these figures and the total for the country given in other tables. For 1920 it amounts to 4,934,000 tons and arises from the fact that in this table the wagon mines and country banks are not included. The slight difference in 1921—less than 2,000 tons for the country as a whole—arises from the fact that the tonnages are rounded to the nearest thousand.

TABLE 15.—*Bituminous coal produced in the several fields adopted by the United States Coal Commission, 1920–21* [a]—Continued

No.	State	General name of field	Number of mines		Tons produced [b]	
			1920	1921	1920	1921
61	Colorado	Trinidad	40	47	4,218,000	2,731,000
62	do	Northern Colorado	41	44	2,682,000	2,187,000
63	Iowa	Marion-Monroe-Polk	111	86	5,920,000	3,701,000
64	do	Appanoose	74	65	1,858,000	831,000
65	Kansas	Pittsburg	137	118	5,592,000	3,270,000
66	do	Lightning Creek	1	1	5,000	11,000
67	do	Osage	21	14	93,000	49,000
68	do	Leavenworth	2	2	105,000	102,000
69	Missouri	Southern Missouri	116	96	3,462,000	2,309,000
70	do	Lafayette	86	71	1,738,000	1,170,000
71	do	Grundy	2	4	47,000	50,000
72	do	Platte	2	1	62,000	52,000
73	Montana	Montana	79	57	4,408,000	2,736,000
74	New Mexico	Gallup	13	15	1,009,000	775,000
75	do	Anthracite	8	6	273,000	201,000
76	do	Raton	16	15	2,383,000	1,462,000
76a	do	Monero	6	5	21,000	23,000
77	North Dakota	Southern North Dakota	40	31	613,000	593,000
78	do	Northern North Dakota	39	29	296,000	276,000
79	Oklahoma	McAlester Vein	28	27	846,000	780,000
80	do	Oklahoma-Eastern	117	105	3,999,000	2,583,000
81	Texas	Texas bituminous	11	8	467,000	156,000
82	do	Texas lignite	33	28	1,149,000	819,000
83	Utah	Utah	39	36	6,004,000	4,078,000
84	Washington	Kittitas County	12	11	1,838,000	1,396,000
85	do	Pierce-King bituminous	26	30	1,479,000	599,000
86	do	Lewis	8	10	384,000	435,000
87	Wyoming	Wyoming	70	64	9,628,000	7,202,000
88	South Dakota	South Dakota	17	18	12,000	6,000
89	Oregon	Oregon	3	2	20,000	24,000
90	California	California	2	1	(d)	12,000
91	Nevada	Nevada	--------	--------	--------	--------
92	North Carolina	North Carolina	1	1	12,000	23,000
	Unclassified		12	13	134,000	100,000
	Total [b] [c]		8,907	8,003	563,756,000	415,923,000

[a] See text for explanation of fields.

[b] A discrepancy will be found between the total of these figures and the total for the country given in other tables. For 1920 it amounts to 4,934,000 tons and arises from the fact that in this table the wagon mines and country banks are not included. The slight difference in 1921—less than 2,000 tons for the country as a whole—arises from the fact that the tonnages are rounded to the nearest thousand.

[c] On account of differences in classification these totals differ slightly from those given in other tables of this report.

[d] Included under "Unclassified."

WEEKLY AND MONTHLY PRODUCTION

SOURCE OF THE DATA

The following tables form a summary of the statistics of the weekly and monthly production of anthracite and bituminous coal that are first published in the Geological Survey's weekly coal reports. The figures given are estimates based upon daily and weekly reports of cars of coal and beehive coke loaded by the principal railroads. They are afterwards revised to agree with the results of the annual statistical reports from the producers of coal, and therefore the figures here given differ slightly from the estimates originally issued in the weekly reports.

To check the estimates of monthly production of anthracite an additional source of information is available in the monthly reports of shipments made by the Anthracite Bureau of Information.

WEEKLY PRODUCTION OF BITUMINOUS COAL

In the bituminous branch of the industry the year 1923 was notably free of those violent extremes in weekly production that have characterized some other years in the modern history of coal mining. The lowest output in a full-time week during the spring and summer, ordinarily the season of lowest production, was 10,414,000 tons in the six days ended May 5. A slowing up of general business caused an unseasonable decline in December, and curiously enough the low mark of the year for a full-time week was reached in that month, ordinarily one in which the output is high. The low point appears to have been 10,174,000 tons in the week ended December 8. The high point was 12,150,000 tons in the week ended September 1. The range between high and low was therefore a little less than 2,000,000 tons, whereas in 1922 the range between the low point of the great strike and the high point of the poststrike recovery was 8,000,000 tons. The conditions of 1922 were of course abnormal, but other recent years have shown ranges of 4,000,000 to 6,000,000 tons between the maximum and minimum weeks. The steadiness of production in 1923 was beyond doubt a factor in enabling the railroads to handle the heavy traffic offered with relatively few complaints of car shortage or other forms of transportation disability.

The figures of total output for each week of the three years 1921-1923 are given in Table 16. Table 17 shows the average production per working day and the number of working days in each week. The daily average is a much fairer basis of comparison from one period to another than the weekly output.

Much interest attaches to the length of the working year in the coal industry. The figures here shown are used after considering evidence of two kinds. The Geological Survey received weekly reports on time actually worked from some 2,500 mines, and these reports indicated the extent to which holidays were observed in each district. The Survey also obtained from the American Railway Association a statement of the total number of cars loaded by the railroads on each day. By comparing the mine reports and the car-loading reports for a given holiday, it was possible to determine accurately the extent to which that holiday was observed in the bituminous-coal fields. It was found that the number of days in the working year is not the same in all districts. All mines observe Sundays, Fourth of July, and Christmas, and most of the mines observe New Year's Day, although under exceptional circumstances, such as the very active demand that prevailed in January, 1923, a considerable tonnage may be loaded on New Year's Day. There are other holidays, such as Eight Hour Day (April 1) and Labor Day, that are very generally observed in union districts but not in nonunion districts, and such days are equivalent over the country as a whole to about three-tenths of a full working day. Similar variations have been noted in the observance of Memorial Day and Thanksgiving Day.

After allowance is made for these holidays, the weighted average potential working year for the country as a whole is 308 days. If, however, Armistice Day continues to be observed as a holiday hereafter, the working year of the bituminous industry will be nearer 307 than 308 days. Other special holidays, of course, such as Presidential Election Day, may cut the working year still further. Such a special interruption to work occurred in 1923, when many mines were closed on August 11, the date of President Harding's funeral. The total number of working days for the year 1923 was therefore 306. There is apparently a tendency to observe more widely certain of the religious holy days. In general, however, these holy days, Columbus Day, and the birthdays of Lincoln and Washington are not yet so commonly observed as to curtail production greatly, and these days have therefore been counted in the table as working days. Individual mines may close on such days, and the aggregate output of a district may show a perceptible decrease, but the records of daily loadings for the country as a whole do not indicate a sufficiently large or sufficiently regular decrease to warrant recognizing them as cutting into the potential working year.

TABLE 16.—*Bituminous coal produced, by weeks, 1921–1923*

1921		1922		1923	
Week ending—	Net tons	Week ending—	Net tons	Week ending—	Net tons
Jan. 1 [a]	282, 000	Jan. 7	7, 739, 000	Jan. 6	11, 379, 000
8	11, 000, 000	14	8, 594, 000	13	11, 611, 000
15	10, 154, 000	21	9, 091, 000	20	11, 308, 000
22	9, 386, 000	28	9, 953, 000	27	11, 371, 000
29	8, 758, 000	Feb. 4	10, 056, 000	Feb. 3	11, 061, 000
Feb. 5	8, 311, 000	11	10, 672, 000	10	11, 102. 000
12	8, 032, 000	18	10, 647, 000	17	10, 798, 000
19	7, 655, 000	25	10, 768, 000	24	10, 687, 000
26	7, 595, 000	Mar. 4	10, 912, 000	Mar. 3	11, 330, 000
Mar. 5	7, 438, 000	11	11, 493, 000	10	11, 001, 000
12	7, 052, 000	18	11, 225, 000	17	10, 795, 000
19	6, 655, 000	25	11, 851, 000	24	10, 791, 000
26	6, 599, 000	Apr. 1	10, 838, 000	31	10, 797, 000
Apr. 2	5, 950, 000	8	3, 970, 000	Apr. 7	9, 967, 000
9	6, 254, 000	15	3, 785, 000	14	10, 767, 000
16	6, 671, 000	22	3, 701, 000	21	10, 580, 000
23	6, 965, 000	29	4, 322, 000	28	10, 459, 000
30	7, 137, 000	May 6	4, 311, 000	May 5	10, 414, 000
May 7	7, 553, 000	13	4, 589, 000	12	10, 533, 000
14	8, 185, 000	20	4, 639, 000	19	10, 631, 000
21	8, 165, 000	27	5, 061, 000	26	11, 437, 000
28	8, 345, 000	June 3	4, 779, 000	June 2	10, 446, 000
June 4	6, 985, 000	10	5, 317, 000	9	11, 051, 000
11	8, 186, 000	17	5, 189, 000	16	10, 945, 000
18	7, 717, 000	24	5, 552, 000	23	10, 789, 000
25	7, 873, 000	July 1	5, 410, 000	30	10, 825, 000
July 2	7, 826, 000	8	3, 807, 000	July 7	9, 050, 000
9	6, 300, 000	15	4, 268, 000	14	11, 309, 000
16	7, 564, 000	22	3, 822, 000	21	11, 051, 000
23	7, 542, 000	29	4, 091, 000	28	11, 197, 000
30	7, 480, 000	Aug. 5	4, 465, 000	Aug. 4	10, 936, 000
Aug. 6	7, 344, 000	12	4, 768, 000	11	10, 197, 000
13	7, 942, 000	19	4, 772, 000	18	11, 224, 000
20	7, 877, 000	26	6, 973, 000	25	11, 783, 000
27	7, 923, 000	Sept. 2	9, 688, 000	Sept. 1	12, 150, 000
Sept. 3	7, 773, 000	9	9, 100, 000	8	10, 854, 000
10	7, 240, 000	16	10, 080, 000	15	11, 777, 000
17	8, 367, 000	23	10, 090, 000	22	11, 856, 000
24	8, 714, 000	30	10, 168, 000	29	11, 745, 000
Oct. 1	9, 085, 000	Oct. 7	10, 079, 000	Oct. 6	11, 075, 000
8	9, 335, 000	14	10, 466, 000	13	11, 338, 000
15	9, 924, 000	21	10, 743, 000	20	11, 070, 000
22	11, 292, 000	28	11, 059, 000	27	11, 303, 000
29	11, 197, 000	Nov. 4	11, 041, 000	Nov. 3	10, 917, 000
Nov. 5	9, 532, 000	11	10, 504, 000	10	11, 103, 000
12	8, 781, 000	18	11, 610, 000	17	10, 058, 000
19	9, 066, 000	25	11, 491, 000	24	10, 518, 000
26	7, 257, 000	Dec. 2	10, 753, 000	Dec. 1	9, 256, 000
Dec. 3	7, 261, 000	9	11, 900, 000	8	10, 174, 000
10	7, 473, 000	16	11, 042, 000	15	10, 285, 000
17	7, 218, 000	23	10, 495, 000	22	10, 914, 000
24	7, 614, 000	30	10, 529, 000	29	6, 949, 000
31	6, 092, 000			Jan. 5 [a]	1, 601, 000
	415, 922, 000		422, 268, 000		564, 565, 000

[a] Figures represent that part of the output in the week which is included in the calendar year shown. The figures of total production for these weeks are as follows: Jan. 1, 1921, 9,854,000; Jan. 5, 1924, 9,378,000.

TABLE 17.—*Number of working days and average production of bituminous coal per working day in each week, 1921–1923*

1921			1922			1923		
Week ending—	Number of working days	Average production (net tons)	Week ending—	Number of working days	Average production (net tons)	Week ending—	Number of working days	Average production (net tons)
Jan. 1	[illegible]	[illegible]	Jan. 7	[illegible]	[illegible]	Jan. 6	[illegible]	[illegible]
8	[illegible]	[illegible]	14	[illegible]	[illegible]	13	[illegible]	[illegible]
15	[illegible]	[illegible]	21	[illegible]	[illegible]	20	[illegible]	[illegible]
22	[illegible]	[illegible]	28	[illegible]	[illegible]	27	[illegible]	[illegible]
29	[illegible]	[illegible]						
Feb. 5	[illegible]	[illegible]	Feb. 4	[illegible]	[illegible]	Feb. 3	[illegible]	[illegible]
12	[illegible]	[illegible]	11	[illegible]	[illegible]	10	[illegible]	[illegible]
19	[illegible]	[illegible]	18	[illegible]	[illegible]	17	[illegible]	[illegible]
26	[illegible]	[illegible]	25	[illegible]	[illegible]	24	[illegible]	[illegible]
Mar. 5	[illegible]	[illegible]	Mar. 4	[illegible]	[illegible]	Mar. 3	[illegible]	[illegible]
12	[illegible]	[illegible]	11	[illegible]	[illegible]	10	[illegible]	[illegible]
19	[illegible]	[illegible]	18	[illegible]	[illegible]	17	[illegible]	[illegible]
26	[illegible]	[illegible]	25	[illegible]	[illegible]	24	[illegible]	[illegible]
						31	[illegible]	[illegible]
Apr. 2	[illegible]	[illegible]	Apr. 1	[illegible]	[illegible]	Apr. 7	[illegible]	[illegible]
9	[illegible]	[illegible]	8	[illegible]	[illegible]	14	[illegible]	[illegible]
16	[illegible]	[illegible]	15	[illegible]	[illegible]	21	[illegible]	[illegible]
23	[illegible]	[illegible]	22	[illegible]	[illegible]	28	[illegible]	[illegible]
30	[illegible]	[illegible]	29	[illegible]	[illegible]			
May 7	[illegible]	[illegible]	May 6	[illegible]	[illegible]	May 5	[illegible]	[illegible]
14	[illegible]	[illegible]	13	[illegible]	[illegible]	12	[illegible]	[illegible]
21	[illegible]	[illegible]	20	[illegible]	[illegible]	19	[illegible]	[illegible]
28	[illegible]	[illegible]	27	[illegible]	[illegible]	26	[illegible]	[illegible]
June 4	[illegible]	[illegible]	June 3	[illegible]	[illegible]	June 2	[illegible]	[illegible]
11	[illegible]	[illegible]	10	[illegible]	[illegible]	9	[illegible]	[illegible]
18	[illegible]	[illegible]	17	[illegible]	[illegible]	16	[illegible]	[illegible]
25	[illegible]	[illegible]	24	[illegible]	[illegible]	23	[illegible]	[illegible]
						30	[illegible]	[illegible]
July 2	[illegible]	[illegible]	July 1	[illegible]	[illegible]	July 7	[illegible]	[illegible]
9	[illegible]	[illegible]	8	[illegible]	[illegible]	14	[illegible]	[illegible]
16	[illegible]	[illegible]	15	[illegible]	[illegible]	21	[illegible]	[illegible]
23	[illegible]	[illegible]	22	[illegible]	[illegible]	28	[illegible]	[illegible]
30	[illegible]	[illegible]	29	[illegible]	[illegible]			
Aug. 6	[illegible]	[illegible]	Aug. 5	[illegible]	[illegible]	Aug. 4	[illegible]	[illegible]
13	[illegible]	[illegible]	12	[illegible]	[illegible]	11	[illegible]	[illegible]
20	[illegible]	[illegible]	19	[illegible]	[illegible]	18	[illegible]	[illegible]
27	[illegible]	[illegible]	26	[illegible]	[illegible]	25	[illegible]	[illegible]
Sept. 3	[illegible]	[illegible]	Sept. 2	[illegible]	[illegible]	Sept. 1	[illegible]	[illegible]
10	[illegible]	[illegible]	9	[illegible]	[illegible]	8	[illegible]	[illegible]
17	[illegible]	[illegible]	16	[illegible]	[illegible]	15	[illegible]	[illegible]
24	[illegible]	[illegible]	23	[illegible]	[illegible]	22	[illegible]	[illegible]
			30	[illegible]	[illegible]	29	[illegible]	[illegible]
Oct. 1	[illegible]	[illegible]	Oct. 7	[illegible]	[illegible]	Oct. 6	[illegible]	[illegible]
8	[illegible]	[illegible]	14	[illegible]	[illegible]	13	[illegible]	[illegible]
15	[illegible]	[illegible]	21	[illegible]	[illegible]	20	[illegible]	[illegible]
22	[illegible]	[illegible]	28	[illegible]	[illegible]	27	[illegible]	[illegible]
29	[illegible]	[illegible]						
Nov. 5	[illegible]	[illegible]	Nov. 4	[illegible]	[illegible]	Nov. 3	[illegible]	[illegible]
12	[illegible]	[illegible]	11	[illegible]	[illegible]	10	[illegible]	[illegible]
19	[illegible]	[illegible]	18	[illegible]	[illegible]	17	[illegible]	[illegible]
26	[illegible]	[illegible]	25	[illegible]	[illegible]	24	[illegible]	[illegible]
Dec. 3	[illegible]	[illegible]	Dec. 2	[illegible]	[illegible]	Dec. 1	[illegible]	[illegible]
10	[illegible]	[illegible]	9	[illegible]	[illegible]	8	[illegible]	[illegible]
17	[illegible]	[illegible]	16	[illegible]	[illegible]	15	[illegible]	[illegible]
24	[illegible]	[illegible]	23	[illegible]	[illegible]	22	[illegible]	[illegible]
31	[illegible]	[illegible]	30	[illegible]	[illegible]	29	[illegible]	[illegible]
						Jan. 5	[illegible]	[illegible]
	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]

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a Number of working days in this week that fell in the year.

b Average daily production for the entire week, not for the working days that fell in the year.

WEEKLY PRODUCTION OF ANTHRACITE

The working year in the anthracite region is somewhat less than the average for the bituminous-coal industry. The region is completely unionized, and the union holidays are therefore observed by practically all mines. In addition to Eight Hour Day (Apr. 1) and Labor Day, the anthracite miners celebrate Mitchell Day (Oct. 29) in memory of the ending of the famous strike of 1902. Other holidays not observed in the nonunion bituminous fields, such as Memorial Day, Thanksgiving, and Armistice Day, are now generally celebrated in the anthracite region. In consequence the theoretical working year for the anthracite mines is 304 days, a figure that makes no allowances for church holy days, many of which are so generally observed as to decrease production seriously.

The statistics of weekly output of anthracite given in the following table are estimated from the records of cars of anthracite loaded by the nine railroads that serve the region. The weekly figures have been adjusted to the annual total ascertained by direct canvass from the operators themselves. Production of anthracite proceeded with its customary steadiness in 1923 except for the period from September 1 to 22, during a part of which the mines were idle pending the renewal of the wage agreement. A small quantity of river coal continued to go forward during this stoppage, but the cessation of production at the mines and washeries themselves was complete. The output in the first quarter of the year was particularly heavy, as the mines were then called upon to make up so far as possible for the shortage resulting from the 1922 strike.

The statistics here given are expressed in net tons and include dredge coal and the output of the Bernice Basin, in Sullivan County.

TABLE 18.—*Estimated weekly production of anthracite, 1922–23, in net tons*

Week ending—	Production	Number of working days	Average production per working day	Week ending—	Production	Number of working days	Average production per working day
1922				1923			
Jan. 7	1,264,000	5	253,000	Jan. 6	1,669,000	5	334,000
14	1,673,000	6	279,000	13	2,044,000	6	341,000
21	1,469,000	6	245,000	20	1,944,000	6	324,000
28	1,636,000	6	273,000	27	2,050,000	6	342,000
Feb. 4	1,844,000	6	307,000	Feb. 3	1,989,000	6	332,000
11	1,855,000	6	309,000	10	1,957,000	6	326,000
18	1,734,000	6	289,000	17	1,768,000	6	295,000
25	1,732,000	6	289,000	24	1,778,000	6	296,000
Mar. 4	1,947,000	6	325,000	Mar. 3	2,035,000	6	339,000
11	2,018,000	6	336,000	10	1,982,000	6	330,000
18	1,941,000	6	324,000	17	1,990,000	6	332,000
25	2,133,000	6	356,000	24	2,057,000	6	343,000
Apr. 1	1,930,000	5	386,000	31	1,942,000	6	324,000
8	9,000	6	2,000	Apr. 7	1,550,000	5	310,000
15	6,000	6	1,000	14	2,000,000	6	333,000
22	6,000	6	1,000	21	1,998,000	6	333,000
29	5,000	6	1,000	28	2,047,000	6	341,000
May 6	6,000	6	1,000	May 5	1,955,000	6	326,000
13	7,000	6	1,000	12	1,841,000	6	307,000
20	8,000	6	1,000	19	1,978,000	6	330,000
27	10,000	6	2,000	26	1,892,000	6	315,000
June 3	8,000	5	2,000	June 2	1,553,000	5	311,000
10	13,000	6	2,000	9	1,979,000	6	330,000
17	22,000	6	4,000	16	1,986,000	6	331,000
24	24,000	6	4,000	23	1,975,000	6	329,000
July 1	25,000	6	4,000	30	2,036,000	6	339,000
8	23,000	5	5,000	July 7	1,528,000	5	306,000
15	32,000	6	5,000	14	1,984,000	6	331,000
22	28,000	6	5,000	21	1,939,000	6	323,000
29	27,000	6	5,000	28	2,012,000	6	201,000
Aug. 5	29,000	6	5,000	Aug. 4	1,952,000	6	325,000
12	40,000	6	7,000	11	1,678,000	6	280,000
19	38,000	6	6,000	18	1,797,000	6	300,000
26	37,000	6	6,000	25	2,094,000	6	349,000
Sept. 2	37,000	6	6,000	Sept. 1	1,831,000	6	305,000
9	51,000	5	10,000	8	3,000	5	600
16	1,127,000	6	188,000	15	2,000	6	300
23	1,897,000	6	316,000	22	848,000	6	141,000
30	1,982,000	6	330,000	29	1,959,000	6	327,000
Oct. 7	1,994,000	6	332,000	Oct. 6	1,949,000	6	325,000
14	2,112,000	6	352,000	13	1,943,000	6	324,000
21	2,039,000	6	340,000	20	1,978,000	6	330,000
28	1,836,000	6	306,000	27	2,001,000	6	334,000
Nov. 4	1,872,000	5	374,000	Nov. 3	1,328,000	5	266,000
11	1,897,000	5	379,000	10	1,903,000	6	317,000
18	2,230,000	6	372,000	17	1,669,000	5	334,000
25	2,213,000	6	369,000	24	2,031,000	6	339,000
Dec. 2	1,852,000	5	370,000	Dec. 1	1,691,000	5	338,000
9	2,075,000	6	346,000	8	1,837,000	6	306,000
16	2,237,000	6	373,000	15	1,947,000	6	325,000
23	2,065,000	6	344,000	22	1,925,000	6	321,000
30	1,588,000	5	318,000	29	1,196,000	5	239,000
				Jan. 5	[a] 319,000	1	[b] 287,000
	54,683,000	303	180,000		93,339,000	304	307,000

[a] Figures represent output in the week included in the calendar year shown.
[b] Average daily production for entire week.

MONTHLY PRODUCTION OF BITUMINOUS COAL

Table 19 gives the monthly and daily average production of bituminous coal for each month from January, 1915, to December, 1923. Comparable figures for the years 1905–1914 will be found in Mineral Resources for 1922, in connection with an extended discussion of the monthly fluctuation in the production of bituminous coal in relation to the business cycle.[5] Plate VI presents the same data graphically. The movements of soft-coal production in response to changes in the general condition of business are more apparent in the annual average production than they are in the figures for individual months. Thus, the light dash line that represents the average output for the year follows with considerable closeness the line representing the movement of general business, but the curve of monthly output is controlled chiefly by factors peculiar to the coal industry.

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[5] U. S. Geol. Survey Mineral Resources, 1922, pt. 2, pp. 462–467, 1924.

The demand for coal is distinctly seasonal, because the consumption is affected by the climate, and in the "odd" years of no wage negotiation a definite seasonal rhythm may be observed in the curve. The "even" years of the pre-war period were marked by recurring peaks of forced production in anticipation of the expiration of the wage agreement and valleys of curtailed production as the mines were closed by strikes. During the war the spring and summer decline was obscured by the abnormal demand of the munitions industry, and in 1923, as pointed out elsewhere (p. 506), the summer trough was filled by heavy purchases for storage. Unless American consumers shall hereafter purchase in the summer the excess over the annual average which they require in the winter, the seasonal character of the consumption will again assert itself in the demand, and variation from a low point in April and May to a high point in October and November may be expected to reappear. The outstanding features of the curve, however, are the canyon-like drops that have attended great strikes, particularly those of 1919 and 1922.[6]

TABLE 19.—*Bituminous coal produced, by months, and average production per working day, 1915–1923, in net tons*

Month	1915		1916		1917	
	Total	Daily average	Total	Daily average	Total	Daily average
January	37, 194, 000	1, 488, 000	46, 593, 000	1, 864, 000	47, 969, 000	1, 845, 000
February	29, 321, 000	1, 222, 000	45, 187, 000	1, 807, 000	41, 353, 000	1, 723, 000
March	31, 801, 000	1, 178, 000	43, 828, 000	1, 623, 000	47, 869, 000	1, 773, 000
April	29, 968, 000	1, 153, 000	33, 628, 000	1, 345, 000	41, 854, 000	1, 674, 000
May	30, 938, 000	1, 190, 000	38, 804, 000	1, 437, 000	47, 086, 000	1, 744, 000
June	33, 957, 000	1, 306, 000	37, 742, 000	1, 452, 000	46, 824, 000	1, 873, 000
July	35, 573, 000	1, 368, 000	38, 113, 000	1, 525, 000	46, 292, 000	1, 852, 000
August	38, 161, 000	1, 468, 000	42, 696, 000	1, 581, 000	47, 372, 000	1, 755, 000
September	40, 964, 000	1, 639, 000	42, 098, 000	1, 619, 000	45, 108, 000	1, 880, 000
October	44, 198, 000	1, 700, 000	44, 807, 000	1, 723, 000	48, 337, 000	1, 790, 000
November	44, 737, 000	1, 789, 000	44, 927, 000	1, 872, 000	47, 690, 000	1, 908, 000
December	45, 814, 000	1, 762, 000	44, 097, 000	1, 764, 000	44, 037, 000	1, 761, 000
	442, 626, 000	1, 437, 000	502, 520, 000	1, 632, 000	551, 791, 000	1, 797, 000

Month	1918		1919		1920	
	Total	Daily average	Total	Daily average	Total	Daily average
January	42, 227, 000	1, 624, 000	42, 193, 000	1, 623, 000	49, 748, 000	1, 913, 000
February	43, 777, 000	1, 824, 000	32, 103, 000	1, 338, 000	41, 055, 000	1, 711, 000
March	48, 113, 000	1, 851, 000	34, 293, 000	1, 319, 000	47, 850, 000	1, 772, 000
April	46, 041, 000	1, 771, 000	32, 712, 000	1, 258, 000	38, 764, 000	1, 491, 000
May	50, 443, 000	1, 868, 000	38, 186, 000	1, 414, 000	39, 841, 000	1, 532, 000
June	51, 138, 000	2, 046, 000	37, 685, 000	1, 507, 000	46, 095, 000	1, 773, 000
July	54, 971, 000	2, 114, 000	43, 425, 000	1, 670, 000	45, 988, 000	1, 769, 000
August	55, 114, 000	2, 041, 000	43, 613, 000	1, 677, 000	49, 974, 000	1, 922, 000
September	51, 183, 000	2, 133, 000	48, 209, 000	1, 928, 000	50, 241, 000	2, 010, 000
October	52, 300, 000	1, 937, 000	57, 200, 000	2, 119, 000	53, 278, 000	2, 049, 000
November	43, 895, 000	1, 756, 000	19, 006, 000	792, 000	52, 576, 000	2, 103, 000
December	40, 184, 000	1, 607, 000	37, 235, 000	1, 432, 000	53, 257, 000	2, 048, 000
	579, 386, 000	1, 881, 000	465, 860, 000	1, 512, 000	568, 667, 000	1, 847, 000

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[6] For an analysis of the seasonal character of consumption and demand and the effect of storage in 1923 upon the demand of that year see Tryon, F. G., and McKenney, W. F., Off-season purchase of railway fuel: International Railway Assoc. Proc. for 1924, pp. 210–239.

TABLE 19.—*Bituminous coal produced, by months, and average production per working day, 1915–1923, in net tons*—Continued

Month	1921		1922		1923	
	Total	Daily average	Total	Daily average	Total	Daily average
January	41, 148, 000	1, 646, 000	38, 930, 000	1, 545, 000	51, 944, 000	1, 975, 000
February	31, 524, 000	1, 314, 000	42, 425, 000	1, 768, 000	43, 645, 000	1, 826, 000
March	31, 054, 000	1, 150, 000	51, 936, 000	1, 924, 000	48, 446, 000	1, 794, 000
April	28, 154, 000	1, 083, 000	16, 335, 000	672, 000	44, 057, 000	1, 806, 000
May	34, 057, 000	1, 362, 000	21, 005, 000	784, 000	47, 690, 000	1, 813, 000
June	34, 635, 000	1, 332, 000	23, 096, 000	888, 000	47, 083, 000	1, 811, 000
July	31, 047, 000	1, 242, 000	17, 602, 000	704, 000	46, 707, 000	1, 868, 000
August	35, 291, 000	1, 307, 000	26, 755, 000	991, 000	50, 578, 000	1, 923, 000
September	35, 870, 000	1, 380, 000	42, 463, 000	1, 678, 000	47, 841, 000	1, 969, 000
October	44, 687, 000	1, 719, 000	46, 733, 000	1, 797, 000	50, 907, 000	1, 885, 000
November	36, 805, 000	1, 472, 000	46, 900, 000	1, 899, 000	44, 425, 000	1, 813, 000
December	31, 650, 000	1, 217, 000	48, 088, 000	1, 924, 000	41, 242, 000	1, 650, 000
	415, 922, 000	1, 356, 000	422, 268, 000	1, 379, 000	564, 565, 000	1, 845, 000

MONTHLY PRODUCTION BY STATES

In Table 20 are given estimates of the production of bituminous coal in each State for each month of 1923. Corresponding data for the years 1917 to 1921 are to be found on pages 469–472 of Mineral Resources for 1921 and data for 1922 on page 473 of Mineral Resources for 1922. The estimates are based on weekly reports of cars of coal and beehive coke loaded by all the large coal-carrying roads, supplemented by monthly reports of coal shipped over waterways. The method of calculation is explained elsewhere.[7]

The monthly estimates for each State are later revised to agree with the final statistics of total output for the year, which are obtained directly from the producers. The revised estimates are sufficiently accurate to show clearly the general trend of output in each State from season to season. For certain States, notably Illinois, Colorado, Indiana, and Utah, the records kept by State officials and local operators' associations have been utilized by adjusting them to agree with the final total production as ascertained by the Geological Survey.

TABLE 20.—*Bituminous coal produced, by States and months, 1923, in net tons*

State	January	February	March	April	May	June	July
Alabama	1, 902, 000	1, 629, 000	1, 902, 000	1, 676, 000	1, 747, 000	1, 677, 000	1, 621, 000
Arkansas	135, 000	101, 000	100, 000	86, 000	86, 000	97, 000	104, 000
Colorado	992, 000	921, 000	879, 000	750, 000	736, 000	759, 000	691, 000
Illinois	9, 256, 000	7, 938, 000	7, 576, 000	5, 983, 000	5, 666, 000	5, 386, 000	5, 284, 000
Indiana	2, 890, 000	2, 439, 000	2, 586, 000	2, 089, 000	1, 725, 000	1, 802, 000	1, 878, 000
Iowa	613, 000	542, 000	551, 000	404, 000	391, 000	383, 000	365, 000
Kansas	449, 000	377, 000	379, 000	319, 000	330, 000	316, 000	318, 000
Kentucky	3, 714, 000	3, 118, 000	3, 488, 000	3, 284, 000	3, 777, 000	3, 657, 000	3, 902, 000
Maryland	239, 000	202, 000	235, 000	211, 000	207, 000	203, 000	176, 000
Michigan	142, 000	105, 000	144, 000	91, 000	52, 000	51, 000	70, 000
Missouri	381, 000	316, 000	271, 000	240, 000	247, 000	238, 000	242, 000
Montana	361, 000	317, 000	309, 000	172, 000	187, 000	163, 000	171. 000
New Mexico	317, 000	233, 000	239, 000	241, 000	253, 000	221, 000	218, 000
North Dakota	220, 000	147, 000	153, 000	63, 000	64, 000	60, 000	60, 000
Ohio	3, 567, 000	2, 764, 000	3, 329, 000	3, 113, 000	3, 770, 000	3, 848, 000	3, 559, 000
Oklahoma	271, 000	245, 000	247, 000	200, 000	200, 000	208, 000	202, 000
Pennsylvania	14, 911, 000	12, 300, 000	14, 620, 000	14, 356, 000	15, 685, 000	15, 656, 000	15, 332, 000
Tennessee	585, 000	505, 000	532, 000	491, 000	529, 000	491, 000	470, 000
Texas	112, 000	93, 000	87, 000	80, 000	94, 000	91, 000	99, 000
Utah	478, 000	382, 000	306, 000	282, 000	323, 000	385, 000	363, 000
Virginia	926, 000	846, 000	1, 035, 000	1, 012, 000	1, 097, 000	1, 038, 000	998, 000
Washington	326, 000	307, 000	333, 000	145, 000	193, 000	193, 000	152, 000
West Virginia	8, 310, 000	7, 170, 000	8, 501, 000	8, 272, 000	9, 826, 000	9, 688, 000	9, 938, 000
Wyoming	817, 000	621, 000	611, 000	472, 000	483, 000	452, 000	477, 000
Other States [a]	30, 000	27, 000	33. 000	25, 000	22, 000	20, 000	17, 000
	51, 944, 000	43, 645, 000	48, 446, 000	44, 057, 000	47, 690, 000	47, 083, 000	46, 707, 000

[a] Alaska, California, Georgia, Idaho, North Carolina, Oregon, and South Dakota.

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[7] Tryon, F. G., Control statistics of coal production and distribution: Am. Statistical Assoc. Quart. Pub., September, 1920, pp. 314–325.

TABLE 20.—*Bituminous coal produced, by States and months, 1923, in net tons*—Continued

State	August	September	October	November	December	Total
Alabama	1, 741, 000	1, 643, 000	1, 793, 000	1, 671, 000	1, 456, 000	20, 458, 000
Arkansas	116, 000	126, 000	126, 000	116, 000	104, 000	1, 297, 000
Colorado	758, 000	866, 000	977, 000	963, 000	1, 054, 000	10, 346, 000
Illinois	5, 973, 000	6, 424, 000	7, 014, 000	6, 416, 000	6, 394, 000	79, 310, 000
Indiana	1, 927, 000	2, 226, 000	2, 337, 000	2, 188, 000	2, 142, 000	26, 229, 000
Iowa	438, 000	474, 000	523, 000	523, 000	504, 000	5, 711, 000
Kansas	369, 000	385, 000	411, 000	416, 000	374, 000	4, 443, 000
Kentucky	4, 303, 000	3, 892, 000	4, 513, 000	3, 847, 000	3, 282, 000	44, 777, 000
Maryland	194, 000	164, 000	159, 000	144, 000	152, 000	2, 286, 000
Michigan	92, 000	109, 000	126, 000	106, 000	84, 000	1, 172, 000
Missouri	268, 000	296, 000	316, 000	300, 000	288, 000	3, 403, 000
Montana	219, 000	275, 000	370, 000	340, 000	264, 000	3, 148, 000
New Mexico	216, 000	229, 000	259, 000	253, 000	236, 000	2, 915, 000
North Dakota	90, 000	109, 000	163, 000	143, 000	114, 000	1, 386, 000
Ohio	3, 817, 000	3, 488, 000	3, 675, 000	3, 120, 000	2, 496, 000	40, 546, 000
Oklahoma	241, 000	263, 000	273, 000	293, 000	242, 000	2, 885, 000
Pennsylvania	16, 370, 000	14, 517, 000	14, 170, 000	12, 222, 000	11, 741, 000	171, 880, 000
Tennessee	517, 000	483, 000	529, 000	481, 000	427, 000	6, 040, 000
Texas	106, 000	104, 000	117, 000	117, 000	87, 000	1, 187, 000
Utah	365, 000	417, 000	546, 000	458, 000	415, 000	4, 720, 000
Virginia	1, 090, 000	991, 000	1, 039, 000	886, 000	804, 000	11, 762, 000
Washington	204, 000	236, 000	305, 000	293, 000	239, 000	2, 926, 000
West Virginia	10, 475, 000	9, 440, 000	10, 320, 000	8, 359, 000	7, 601, 000	107, 900, 000
Wyoming	672, 000	669, 000	829, 000	750, 000	722, 000	7, 575, 000
Other States [a]	17, 000	15, 000	17, 000	20, 000	20, 000	263, 000
	50, 578, 000	47, 841, 000	50, 907, 000	44, 425, 000	41, 242, 000	564, 565, 000

[a] Alaska, California, Georgia, Idaho, North Carolina, Oregon, and South Dakota.

MONTHLY PRODUCTION OF ANTHRACITE

The monthly statistics of anthracite production given in Table 21 include the output of dredge and washery coal and the production of the Bernice Basin, Sullivan County. They are based in part on reports of cars of coal loaded by the principal carriers, in part on the monthly statements of shipments issued by the Anthracite Bureau of Information. The output of March, 1923, has been exceeded but four times in the period covered by the statistical record. The suspension beginning September 1 cut production in that month to 2,853,000 net tons. The fluctuations in the monthly production of anthracite from 1911 to 1922 were discussed in the report for 1922.[8]

TABLE 21.—*Anthracite produced, by months, and average production per working day, 1915–1923, in net tons*

Month	1915		1916		1917	
	Total	Daily average	Total	Daily average	Total	Daily average
January	6, 337, 000	253, 000	7, 649, 000	306, 000	7, 672, 000	295, 000
February	5, 703, 000	238, 000	7, 404, 000	296, 000	6, 688, 000	279, 000
March	6, 654, 000	246, 000	7, 964, 000	295, 000	9, 026, 000	334, 000
April	8, 725, 000	336, 000	5, 887, 000	235, 000	7, 222, 000	289, 000
May	7, 807, 000	300, 000	7, 212, 000	267, 000	8, 933, 000	331, 000
June	7, 157, 000	275, 000	7, 327, 000	282, 000	9, 103, 000	364, 000
July	6, 691, 000	257, 000	7, 062, 000	282, 000	8, 684, 000	347, 000
August	7, 161, 000	275, 000	7, 190, 000	266, 000	9, 058, 000	335, 000
September	7, 423, 000	297, 000	7, 206, 000	277, 000	8, 230, 000	343, 000
October	8, 761, 000	337, 000	7, 630, 000	293, 000	9, 183, 000	340, 000
November	8, 514, 000	341, 000	7, 790, 000	325, 000	8, 453, 000	338, 000
December	8, 062, 000	310, 000	7, 257, 000	290, 000	7, 360, 000	294, 000
	88, 995, 000	289, 000	87, 578, 000	284, 000	99, 612, 000	324, 000

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[8] U. S. Geol. Survey Mineral Resources, 1922, pt. 2, pp. 465-467, 1924.

TABLE 21.—*Anthracite produced, by months, and average production per working day, 1915–1923, in net tons*—Continued

Month	1918		1919		1920	
	Total	Daily average	Total	Daily average	Total	Daily average
January	7, 270, 000	280, 000	7, 819, 000	301, 000	7, 459, 000	287, 000
February	7, 494, 000	312, 000	5, 102, 000	213, 000	6, 415, 000	267, 000
March	9, 382, 000	361, 000	5, 190, 000	200, 000	7, 935, 000	294, 000
April	8, 211, 000	316, 000	6, 884, 000	275, 000	6, 285, 000	251, 000
May	8, 880, 000	329, 000	7, 525, 000	289, 000	8, 037, 000	321, 000
June	8, 855, 000	354, 000	7, 404, 000	296, 000	8, 251, 000	317, 000
July	9, 134, 000	351, 000	7, 974, 000	307, 000	8, 342, 000	321, 000
August	9, 258, 000	343, 000	8, 096, 000	311, 000	8, 105, 000	312, 000
September	8, 038, 000	335, 000	7, 494, 000	300, 000	4, 691, 000	188, 000
October	8, 105, 000	300, 000	8, 645, 000	333, 000	8, 148, 000	326, 000
November	6, 803, 000	272, 000	7, 870, 000	342, 000	7, 527, 000	314, 000
December	7, 396, 000	296, 000	8, 089, 000	311, 000	8, 403, 000	323, 000
	98, 826, 000	321, 000	88, 092, 000	290, 000	89, 598, 000	295, 000

Month	1921		1922		1923	
	Total	Daily average	Total	Daily average	Total	Daily average
January	7, 681, 000	307, 000	6, 566, 000	263, 000	8, 521, 000	328, 000
February	7, 983, 000	333, 000	7, 096, 000	296, 000	7, 602, 000	317, 000
March	7, 677, 000	284, 000	9, 181, 000	340, 000	9, 175, 000	340, 000
April	7, 985, 000	319, 000	27, 000	1, 000	7, 885, 000	329, 000
May	7, 752, 000	310, 000	36, 000	1, 000	8, 384, 000	322, 000
June	8, 071, 000	310, 000	86, 000	3, 000	8, 474, 000	326, 000
July	7, 309, 000	292, 000	118, 000	5, 000	8, 136, 000	325, 000
August	7, 459, 000	276, 000	164, 000	6, 000	8, 672, 000	321, 000
September	7, 385, 000	295, 000	5, 075, 000	203, 000	2, 853, 000	119, 000
October	7, 858, 000	314, 000	8, 896, 000	356, 000	8, 532, 000	328, 000
November	7, 110, 000	296, 000	8, 695, 000	362, 000	7, 575, 000	316, 000
December	6, 203, 000	239, 000	8, 743, 000	350, 000	7, 530, 000	301, 000
	90, 473, 000	298, 000	54, 683, 000	180, 000	93, 339, 000	307, 000

PRODUCTION FROM 1807 TO 1923

Coal was mined in the Richmond Basin before the Revolution, but the Geological Survey has been unable to discover any account of the quantities produced. The statistical record of the industry begins with the first shipments of Pennsylvania anthracite in 1807, and the amounts produced before that date must have been very small. The following table, compiled by L. Mann and E. W. Parker from all available sources, gives the production of anthracite and of bituminous coal for the period 1807 to 1820 and for each year thereafter. For the years prior to 1880, when the annual reports of the United States Geological Survey began, the main reliance of the compilers was the decennial census, supplemented by records from State and trade sources. In the absence of other information, estimates were made for the intercensus years to round out the totals.

TABLE 22.—*Coal produced, 1807–1923, in net tons*

Year	Pennsylvania	Virginia	Kentucky	Illinois	Ohio	Pennsylvania	Missouri
	Anthracite					*Bituminous*	
1807-1820	12,000	----------	----------	----------	----------	----------	----------
1821	1,322	----------	----------	----------	----------	----------	----------
1822	4,583	54,000	----------	----------	----------	----------	----------
1823	8,563	60,000	----------	----------	----------	----------	----------
1824	13,685	67,040	----------	----------	----------	----------	----------
1825	42,988	75,000	----------	----------	----------	----------	----------
1826	59,194	88,720	----------	----------	----------	----------	----------
1827	78,151	94,000	----------	----------	----------	----------	----------
1828	95,500	100,080	328	----------	----------	----------	----------
1829	138,086	100,000	2,000	----------	----------	----------	----------
1830	215,272	102,800	2,000	----------	----------	----------	----------
1831	217,842	118,000	2,100	----------	----------	----------	----------
1832	447,550	132,000	2,500	----------	----------	----------	----------
1833	600,907	125,000	2,750	6,000	----------	----------	----------
1834	464,015	124,000	5,000	7,500	----------	----------	----------
1835	690,854	120,000	6,000	8,000	----------	----------	----------
1836	842,832	124,000	8,000	10,000	----------	----------	----------
1837	1,071,151	160,000	10,000	12,500	----------	----------	----------
1838	910,075	300,000	11,500	14,000	119,952	----------	----------
1839	1,008,322	396,000	16,000	15,038	125,000	----------	----------
1840	967,108	424,894	23,527	16,967	140,536	464,826	9,972
1841	1,182,441	379,600	35,000	35,000	160,000	475,000	12,000
1842	1,365,563	373,640	50,000	58,000	225,000	500,000	15,000
1843	1,556,753	370,000	60,000	75,000	280,000	650,000	25,000
1844	2,009,207	365,000	75,000	120,000	340,000	675,000	35,000
1845	2,480,032	350,000	100,000	150,000	390,000	700,000	50,000
1846	2,887,815	340,000	115,000	165,000	420,000	760,000	68,000
1847	3,551,005	325,000	120,000	180,000	480,000	399,840	80,000
1848	3,805,942	318,000	125,000	200,000	540,000	500,000	85,000
1849	3,995,334	315,000	140,000	260,000	600,000	750,000	90,000
1850	4,138,164	310,000	150,000	300,000	640,000	1,000,000	100,000
1851	5,481,065	310,000	160,000	320,000	670,000	1,200,000	125,000
1852	6,151,957	325,000	175,000	340,000	700,000	1,400,000	140,000
1853	6,400,426	350,000	180,000	375,000	760,000	1,500,000	160,000
1854	7,394,875	370,000	190,000	385,000	800,000	1,650,000	175,000
1855	8,141,754	380,782	200,000	400,000	890,000	1,780,000	185,000
1856	8,534,779	352,687	215,000	410,000	930,000	1,850,000	200,000
1857	8,186,567	363,605	240,000	450,000	975,000	2,000,000	220,000
1858	8,426,102	377,690	250,000	490,000	1,000,000	2,200,000	240,000
1859	9,619,771	359,055	275,000	530,000	1,060,000	2,400,000	260,000
1860	8,115,842	473,360	285,760	728,400	1,265,600	2,690,786	280,000
1861	9,799,654	445,165	280,000	670,000	1,150,000	3,200,000	300,000
1862	9,695,110	445,124	275,000	780,000	1,200,000	4,000,000	320,000
1863	11,785,320	40,000	250,000	890,000	1,204,581	5,000,000	360,000
1864	12,538,649	40,000	250,000	1,000,000	1,815,622	5,839,000	375,000
1865	11,891,746	40,000	200,000	1,260,000	1,536,218	6,350,000	420,000
1866	15,651,183	40,000	180,000	1,580,000	1,887,424	6,800,000	450,000
1867	16,002,109	50,000	175,000	1,800,000	2,092,334	7,300,000	500,000
1868	17,003,405	59,051	160,000	2,000,000	2,475,844	7,500,000	541,000
1869	17,083,134	65,000	160,000	1,854,000	2,461,986	6,750,000	550,000
1870	15,664,275	61,803	150,582	2,624,163	2,527,285	7,798,518	621,930
1871	19,342,057	70,000	250,000	3,000,000	4,000,000	9,040,565	725,000
1872	24,233,166	69,440	380,800	3,360,000	5,315,294	11,695,040	784,000
1873	26,152,837	67,200	400,000	3,920,000	4,550,028	13,098,829	784,000
1874	24,818,790	70,000	360,000	4,203,000	3,267,585	12,320,000	789,680
1875	22,485,766	60,000	500,000	4,453,178	4,864,259	11,760,000	840,000
1876	22,793,245	55,000	650,000	5,000,000	3,500,000	12,880,000	1,008,000
1877	25,660,316	50,000	850,000	5,350,000	5,250,000	14,000,000	1,008,000
1878	21,689,682	50,000	900,000	5,700,000	5,500,000	15,120,000	1,008,000
1879	30,207,793	45,000	1,000,000	5,000,000	6,000,000	16,240,000	1,008,000
1880	28,649,812	43,079	946,288	6,115,377	6,008,595	18,425,163	844,304
1881	31,920,018	50,000	1,232,000	6,720,000	9,240,000	22,400,000	1,960,000
1882	35,121,256	112,000	1,300,000	9,115,653	9,450,000	24,640,000	2,240,000
1883	38,456,845	252,000	1,650,000	12,123,456	8,229,429	26,880,000	2,520,000
1884	37,156,847	336,000	1,550,000	12,208,075	7,640,062	28,000,000	2,800,000
1885	38,335,974	567,000	1,600,000	11,834,459	7,816,179	26,000,000	3,080,000
1886	39,035,446	684,951	1,550,000	11,175,241	8,435,211	27,094,501	1,800,000
1887	42,088,197	825,263	1,933,185	12,423,066	10,300,708	31,516,856	3,209,916
1888	46,619,564	1,073,000	2,570,000	14,328,181	10,910,951	33,796,727	3,909,967
1889	45,546,970	865,786	2,399,755	12,104,272	9,976,787	36,174,089	2,557,823

TABLE 22.—*Coal produced, 1807–1923, in net tons*—Continued

Year	Pennsylvania	Virginia	Kentucky	Illinois	Ohio	Pennsylvania	Missouri
	Anthracite					*Bituminous*	
1890	46, 468, 641	784, 011	2, 701, 496	15, 292, 420	11, 494, 506	42, 302, 173	2, 735, 221
1891	50, 665, 431	736, 399	2, 916, 069	15, 660, 698	12, 868, 683	42, 788, 490	2, 674, 606
1892	52, 472, 504	675, 205	3, 025, 303	17, 862, 276	13, 562, 927	46, 694, 576	2, 733, 949
1893	53, 967, 543	820, 339	3, 007, 179	19, 949, 564	13, 253, 646	44, 070. 724	2, 897, 442
1894	51, 921, 121	1, 229, 083	3, 111, 192	17, 113, 576	11, 909, 856	39, 912, 463	2, 245, 039
1895	57, 999, 337	1, 368, 324	3, 357, 770	17, 735, 864	13, 355, 806	50, 217, 228	2, 372, 393
1896	54, 346, 081	1, 254, 723	3, 333, 478	19, 786, 626	12, 875, 202	49, 557, 453	2, 331, 542
1897	52, 611, 680	1, 528, 302	3, 602, 097	20, 072, 758	12, 196, 942	54, 417, 974	2, 665, 626
1898	53, 382, 644	1, 815, 274	3, 887, 908	18, 599, 299	14, 516, 867	65, 165, 133	2, 688, 321
1899	60, 418, 005	2, 105, 791	4, 607, 255	24, 439, 019	16, 500, 270	74, 150, 175	3, 025, 814
1900	57, 367, 915	2, 393, 754	5, 328, 964	25, 767, 981	18, 988, 150	79, 842, 326	3, 540, 103
1901	67, 471, 667	2, 725, 873	5, 469, 986	27, 331, 552	20, 943, 807	82, 305, 946	3, 802, 088
1902	41, 373, 595	3, 182, 993	6, 766, 984	32, 939, 373	23, 519, 894	98, 574, 367	3, 890, 154
1903	74, 607, 068	3, 451, 307	7, 538, 032	36, 957, 104	24, 838, 103	103, 117, 178	4, 238, 586
1904	73, 156, 709	3, 410, 914	7, 576, 482	36, 475, 060	24, 400, 220	97, 938, 287	4, 168, 308
1905	77, 659, 850	4, 275, 271	8, 432, 523	38, 434, 363	25, 552, 950	118, 413, 637	3, 983, 378
1906	71, 282, 411	4, 254, 879	9, 653, 647	41, 480, 104	27, 731, 640	129, 293, 206	3, 758, 008
1907	85, 604, 312	4, 710, 895	10, 753, 124	51, 317, 146	32, 142, 419	150, 143, 177	3, 997, 936
1908	83, 268, 754	4, 259, 042	10, 246, 553	47, 659, 690	26, 270, 639	117, 179, 527	3, 317, 315
1909	81, 070, 359	4, 752, 217	10, 697, 384	50, 904, 990	27, 939, 641	137, 966, 791	3, 756, 530
1910	84, 485, 236	6, 507, 997	14, 623, 319	45, 900, 246	34, 209, 668	150, 521, 526	2, 982, 433
1911	90, 464, 067	6, 864, 667	14, 049, 703	53, 679, 118	30, 759, 986	144, 561, 257	3, 836, 107
1912	84, 361, 598	7, 846, 638	16, 490, 521	59, 885, 226	34, 528, 727	161, 865, 488	4, 339, 856
1913	91, 524, 922	8, 828, 068	19, 616, 600	61, 618, 744	36, 200, 527	173, 781, 217	4, 318, 125
1914	90, 821, 507	7, 959, 535	20, 382, 763	57, 589, 197	18, 843, 115	147, 983, 294	3, 935, 980
1915	88, 995, 061	8, 122, 596	21, 361, 674	58, 829, 576	22, 434, 691	157, 955, 137	3, 811, 593
1916	87, 578, 493	9, 707, 474	25, 393, 997	66, 195, 336	34, 728, 219	170, 295, 424	4, 742, 146
1917	99, 611, 811	10, 087, 091	27, 807, 971	86, 199, 387	40, 748, 734	172, 448, 142	5, 670, 549
1918	98, 826, 084	10, 289, 808	31, 612, 617	89, 291, 105	45, 812, 943	178, 550, 741	5, 667, 730
1919	88, 092, 201	9, 326, 830	30, 036, 061	60, 862, 608	35, 876, 682	150, 758, 154	3, 979, 798
1920	89, 598, 249	11, 378, 606	35, 690, 762	88, 724, 893	45, 878, 191	170, 607, 847	5, 369, 565
1921	90, 473, 451	7, 492, 378	31, 588, 270	69, 602, 763	31, 942, 776	116, 013, 942	3, 551, 621
1922	54, 683, 022	10, 491, 174	42, 134, 175	58, 467, 736	26, 953, 791	113, 148, 308	2, 924, 750
1923	93, 339, 009	11, 761, 643	44, 777, 317	79, 310, 075	40, 546, 443	171, 879, 913	3, 403, 151
	3, 328, 714, 898	192, 904, 916	518, 914, 251	1, 680, 588, 999	1, 026, 444, 131	4, 281, 585, 961	163, 225, 355

Year	Indiana	Alabama	Tennessee	Iowa	Arkansas	North Carolina	Maryland	Washington	Michigan
1807–1820	----------	----------	----------	----------	----------	------	3, 000	----------	----------
1832	----------	----------	----------	----------	----------	------	12, 000	----------	----------
1840	9, 682	946	558	400	220	3	8, 880	----------	----------
1841	10, 000	1, 000	600	500	----------	------	----------	----------	----------
1842	18, 000	1, 000	1, 000	750	----------	------	2, 104	----------	----------
1843	25, 000	1, 200	4, 500	1, 000	----------	------	12, 421	----------	----------
1844	30, 000	1, 200	10, 000	2, 500	----------	------	18, 345	----------	----------
1845	35, 000	1, 500	18, 000	5, 000	----------	------	30, 372	----------	----------
1846	40, 000	1, 500	25, 000	6, 500	----------	------	36, 707	----------	----------
1847	45, 000	2, 000	30, 000	8, 000	----------	------	65, 222	----------	----------
1848	50, 000	2, 000	40, 000	10, 000	----------	------	98, 032	----------	----------
1849	56, 000	2, 500	52, 000	12, 500	----------	------	175, 497	----------	----------
1850	60, 000	2, 500	60, 000	15, 000	----------	------	242, 517	----------	----------
1851	60, 000	3, 000	70, 000	18, 000	----------	------	317, 460	----------	----------
1852	75, 000	3, 000	75, 000	20, 000	----------	------	411, 707	----------	----------
1853	75, 000	4, 000	85, 000	23, 000	----------	------	657, 862	----------	----------
1854	80, 000	4, 500	90, 000	25, 000	----------	------	812, 727	----------	----------
1855	80, 000	6, 000	100, 000	28, 000	----------	------	735, 137	----------	----------
1856	85, 000	6, 800	115, 000	30, 000	----------	------	817, 659	----------	----------
1857	85, 000	8, 000	125, 000	33, 000	----------	------	654, 017	----------	----------
1858	87, 000	8, 500	135, 000	37, 500	----------	------	722, 686	----------	----------
1859	95, 000	9, 000	150, 000	42, 000	----------	------	833, 349	----------	----------

Table 22.—*Coal produced, 1807–1923, in net tons*—Continued

Year	Indiana	Alabama	Tennessee	Iowa	Arkansas	North Carolina	Maryland	Washington	Michigan
1860	101, 280	10, 200	165, 300	41, 920	200	-------	438, 000	5, 374	2, 320
1861	128, 000	10, 000	150, 000	50, 000	----------	-------	287, 073	6, 000	3, 000
1862	150, 000	12, 500	140, 000	53, 000	----------	30, 000	346, 201	7, 000	5, 000
1863	200, 000	15, 000	100, 000	57, 000	----------	30, 000	877, 313	8, 000	8, 000
1864	250, 000	15, 000	100, 000	63, 000	----------	25, 000	755, 764	10, 000	12, 000
1865	280, 000	12, 000	100, 000	69, 574	----------	20, 000	1, 025, 208	12, 000	15, 000
1866	320, 000	12, 000	100, 000	99, 320	----------	20, 000	1, 217, 668	13, 000	20, 000
1867	350, 000	10, 000	110, 000	150, 000	----------	20, 000	1, 381, 429	14, 500	25, 000
1868	375, 000	10, 000	125, 000	241, 453	----------	18, 000	1, 529, 879	15, 000	28, 000
1869	400, 000	10, 000	130, 000	295, 105	----------	16, 000	2, 216, 300	16, 200	29, 980
1870	437, 870	11, 000	133, 418	263, 487	----------	15, 000	1, 819, 824	17, 844	28, 150
1871	600, 000	15, 000	180, 000	300, 000	----------	15, 000	2, 670, 338	20, 000	32, 000
1872	896, 000	16, 800	224, 000	336, 000	----------	12, 000	2, 647, 156	23, 000	33, 600
1873	1, 000, 000	44, 800	350, 000	392, 000	----------	10, 000	3, 198, 911	26, 000	56, 000
1874	812, 000	50, 400	350, 000	799, 936	----------	-------	2, 899, 392	30, 352	58, 000
1875	800. 000	67, 200	360, 000	1, 231, 547	----------	-------	2, 808, 018	99, 568	62, 500
1876	950, 000	112, 000	550, 000	1, 250, 000	----------	-------	2, 126, 873	110, 342	66, 000
1877	1, 000, 000	196, 000	450, 000	1, 300, 000	----------	-------	1, 939, 575	120, 896	69, 197
1878	1, 000, 000	224, 000	375, 000	1, 350, 000	----------	-------	2, 068, 925	131, 660	85, 322
1879	1, 196, 490	280, 000	450, 000	1, 400, 000	----------	-------	2, 132, 233	142, 666	82, 015
1880	1, 454, 327	323, 972	495, 131	1, 461, 116	14, 778	350	2, 228, 917	145, 015	100, 800
1881	1, 984, 120	420, 000	840, 000	1, 960, 000	20, 000	300	2, 533, 348	196, 000	112, 000
1882	1, 976, 470	896, 000	850, 000	3, 920, 000	25, 000	400	1, 555, 445	177, 340	135, 339
1883	2, 560, 000	1, 568, 000	1, 000, 000	4, 457, 540	50, 000	400	2, 476, 075	244, 990	71, 296
1884	2, 260, 000	2, 240, 000	1, 200, 000	4, 370, 566	75, 000	500	2, 765, 617	166, 936	36, 712
1885	2, 375, 000	2, 492, 000	1, 440, 957	4, 012, 575	100, 000	500	2, 833, 337	380, 250	45, 178
1886	3, 000, 000	1, 800, 000	1, 714, 290	4, 315, 779	125, 000	400	2, 517, 577	423, 525	60, 434
1887	3, 217, 711	1, 950, 000	1, 900, 000	4, 473, 828	129, 600	300	3, 278, 023	772, 601	71, 461
1888	3, 140, 979	2, 900, 000	1, 967, 297	4, 952, 440	276, 871	250	3, 479, 470	1, 215, 750	81, 407
1889	2, 845, 057	3, 572, 983	1, 925, 689	4, 095, 358	279, 584	222	2, 939, 715	1, 030, 578	67, 431
1890	3, 305, 737	4, 090, 409	2, 169, 585	4, 021, 739	399, 888	10, 262	3, 357, 813	1, 263, 689	74, 977
1891	2, 973, 474	4, 759, 781	2, 413, 678	3, 825, 495	542, 379	20, 355	3, 820, 239	1, 056, 249	80, 307
1892	3, 345, 174	5, 529, 312	2, 092, 064	3, 918, 491	535, 558	6, 679	3, 419, 962	1, 213, 427	77, 990
1893	3, 791, 851	5, 136, 935	1, 902, 258	3, 972, 229	574, 763	17, 000	3, 716, 041	1, 264, 877	45, 979
1894	3, 423, 921	4, 397, 178	2, 180, 879	3, 967, 253	512, 626	16, 900	3, 501, 428	1, 106, 470	70, 022
1895	3, 995, 892	5, 693, 775	2, 535, 644	4, 156, 074	598, 322	24, 900	3, 915, 585	1, 191, 410	112, 322
1896	3, 905, 779	5, 748, 697	2, 663, 106	3, 954, 028	675, 374	7, 813	4, 143, 936	1, 195, 504	92, 882
1897	4, 151, 169	5, 893, 770	2, 888, 849	4, 611, 865	856, 190	21, 280	4, 442, 128	1, 434, 112	223, 592
1898	4, 920, 743	6, 535, 283	3, 022, 896	4, 618, 842	1, 205, 479	11, 495	4, 674, 884	1, 884, 571	315, 722
1899	6, 006, 523	7, 593, 416	3, 330, 659	5, 177, 479	843, 554	26, 896	4, 807, 396	2, 029, 881	624, 708
1900	6, 484, 086	8, 394, 275	3, 509, 562	5, 202, 939	1, 447, 945	17, 734	4, 024, 688	2, 474, 093	849, 475
1901	6, 918, 225	9, 099, 052	3, 633, 290	5, 617, 499	1, 816, 136	12, 000	5, 113, 127	2, 578, 217	1, 241, 241
1902	9, 446, 424	10, 354, 570	4, 382, 968	5, 904, 766	1, 943, 932	23, 000	5, 271, 609	2, 681, 214	964, 718
1903	10, 794, 692	11, 654, 324	4, 798, 004	6, 419, 811	2, 229, 172	17, 309	4, 846, 165	3, 193, 273	1, 367, 619
1904	10, 842, 189	11, 262, 046	4, 782, 211	6, 519, 933	2, 009, 451	7, 000	4, 813, 622	3, 137, 681	1, 342, 840
1905	11, 895, 252	11, 866, 069	5, 766, 690	6, 798, 609	1, 934, 673	1, 557	5, 108, 539	2, 864, 926	1, 473, 211
1906	12, 092, 560	13, 107, 963	6, 259, 275	7, 266, 224	1, 864, 268	-------	5, 435, 453	3, 276, 184	1, 346, 338
1907	13, 985, 713	14, 250, 454	6, 810, 243	7, 574, 322	2, 670, 438	-------	5, 532, 628	3, 680, 532	2, 035, 858
1908	12, 314, 890	11, 604, 593	6, 199, 171	7, 161, 310	2, 078, 357	-------	4, 377, 093	3, 024, 943	1, 835, 019
1909	14, 834, 259	13, 703, 450	6, 358, 645	7, 757, 762	2, 377, 157	-------	4, 023, 241	3, 602, 263	1, 784, 692
1910	18, 389, 815	16, 111, 462	7, 121, 380	7, 928, 120	1, 905, 958	-------	5, 217, 125	3, 911, 899	1, 534, 967
1911	14, 201, 355	15, 021, 421	6, 433, 156	7, 331, 648	2, 106, 789	120	4, 685, 795	3, 572, 815	1, 476, 074
1912	15, 285, 718	16, 100, 600	6, 473, 228	7, 289, 529	2, 100, 819	200	4, 964, 038	3, 360, 932	1, 206, 230
1913	17, 165, 671	17, 678, 522	6, 860, 184	7, 525, 936	2, 234, 107	-------	4, 779, 839	3, 877, 891	1, 231, 786
1914	16, 641, 132	15, 593, 422	5, 943, 258	7, 451, 022	1, 836, 540	-------	4, 133, 547	3, 064, 820	1, 283, 030
1915	17, 006, 152	14, 927, 937	5, 730, 361	7, 614, 143	1, 652, 106	-------	4, 180, 477	2, 429, 095	1, 156, 138
1916	20, 093, 528	18, 086, 197	6, 137, 449	7, 260, 800	1, 994, 915	-------	4, 460, 046	3, 038, 588	1, 180, 360
1917	26, 539, 329	20, 068, 074	6, 194, 221	8, 965, 830	2, 143, 579	-------	4, 745, 924	4, 009, 902	1, 374, 805
1918	30, 678, 634	19, 184, 962	6, 831, 048	8, 192, 195	2, 227, 369	1, 420	4, 497, 297	4, 082, 212	1, 464, 818
1919	20, 912, 288	15, 536, 721	5, 213, 205	5, 624, 692	1, 429, 020	6, 989	3, 021, 686	2, 990, 447	996, 545
1920	29, 350, 585	16, 294, 099	6, 662, 428	7, 813, 916	2, 103, 596	11, 540	4, 065, 239	3, 757, 093	1, 489, 765
1921	20, 319, 509	12, 568, 899	4, 460, 326	4, 531, 392	1, 227, 777	23, 438	1, 827, 740	2, 428, 722	1, 141, 715
1922	19, 132, 889	18, 324, 740	4, 876, 774	4, 335, 161	1, 110, 046	78, 570	1, 222, 707	2, 581, 165	929, 390
1923	26, 229, 099	20, 457, 649	6, 040, 268	5, 710, 735	1, 296, 892	36, 019	2, 285, 926	2, 926, 392	1, 172, 075
	478, 535, 243	425, 997, 058	181, 839, 703	254, 102, 983	53, 581, 428	635, 101	210, 094, 268	95, 767, 876	35, 100, 352

TABLE 22.—*Coal produced, 1807–1923, in net tons*—Continued

Year	Georgia	California	West Virginia	Colorado	Wyoming	Kansas	Utah	Oklahoma (Indian Territory)
1860	1, 900	----------	----------	----------	----------	----------	----------	----------
1861	2, 500	6, 620	----------	----------	----------	----------	----------	----------
1862	3, 500	23, 400	----------	----------	----------	----------	----------	----------
1863	6, 000	43, 200	444, 648	----------	----------	----------	----------	----------
1864	10, 000	50, 700	454, 888	500	----------	----------	----------	----------
1865	10, 000	60, 530	487, 897	1, 200	800	----------	----------	----------
1866	8, 000	84, 020	512, 068	6, 400	2, 500	----------	----------	----------
1867	8, 000	124, 690	589, 360	17, 000	5, 000	----------	----------	----------
1868	10, 000	143, 676	609, 227	10, 500	6, 925	----------	----------	----------
1869	12, 000	157, 234	603, 148	8, 000	49, 382	36, 891	----------	----------
1870	15, 000	141, 890	608, 878	4, 500	50, 000	32, 938	5, 800	----------
1871	20, 000	152, 493	618, 830	15, 600	147, 328	41, 000	----------	----------
1872	25, 000	190, 859	700, 000	68, 540	221, 745	44, 800	----------	----------
1873	40, 000	186, 611	1, 000, 000	69, 997	259, 700	56, 000	----------	----------
1874	60, 000	215, 352	1, 120, 000	77, 372	219, 061	85, 000	----------	----------
1875	80, 000	166, 638	1, 120, 000	98, 838	300, 808	150, 000	----------	----------
1876	110, 000	128, 049	896, 000	117, 666	334, 550	225, 000	50, 400	----------
1877	120, 000	107, 789	1, 120, 000	160, 000	342, 853	300, 000	50, 400	----------
1878	128, 000	134, 237	1, 120, 000	200, 630	333, 200	375, 000	67, 200	----------
1879	140, 000	147, 879	1, 400, 000	322, 732	400, 991	460, 000	50, 000	----------
1880	154, 644	236, 950	1, 829, 844	462, 747	589, 595	771, 442	14, 748	120, 947
1881	168, 000	140, 000	1, 680, 000	706, 744	420, 000	840, 000	52, 000	150, 000
1882	160, 000	112, 592	2, 240, 000	1, 061, 479	707, 764	750, 000	100, 000	200, 000
1883	155, 000	76, 162	2, 335, 833	1, 229, 593	779, 689	900, 000	200, 000	350, 000
1884	150, 000	77, 485	3, 360, 000	1, 130, 024	902, 620	1, 100, 000	200, 000	425, 000
1885	150, 000	71, 615	3, 369, 062	1, 356, 062	807, 328	1, 212, 057	213, 120	500, 000
1886	223. 000	100, 000	4, 005, 796	1, 368, 338	829, 355	1, 400, 000	200, 000	534, 580
1887	313. 715	50, 000	4, 881, 620	1, 791, 735	1, 170, 318	1, 596, 879	180, 021	685, 911
1888	180, 000	95, 000	5, 498, 800	2, 185, 477	1, 481, 540	1, 850, 000	258. 961	761, 986
1889	225, 934	119, 820	6, 231, 880	2, 597, 181	1, 388, 947	2, 221, 043	236, 651	752, 832
1890	228, 337	110, 711	7, 394, 654	3, 077, 003	1, 870, 366	2, 259, 922	318, 159	869, 229
1891	171, 000	93, 301	9, 220, 665	3, 512, 632	2, 327, 841	2, 716, 705	371, 045	1, 091, 032
1892	215, 498	85. 178	9, 738, 755	3, 510, 830	2, 503, 839	3, 007, 276	361, 013	1, 192, 721
1893	372, 740	72, 603	10, 708, 578	4, 102, 389	2, 439, 311	2, 652, 546	413, 205	1, 252, 110
1894	354, 111	67, 247	11, 627, 757	2, 831, 409	2, 417, 463	3, 388, 251	431, 550	969, 606
1895	260, 998	75, 453	11, 387, 961	3, 082, 982	2, 246, 911	2, 926, 870	471, 836	1, 211, 185
1896	238, 546	78, 544	12, 876, 296	3, 112, 400	2, 229, 624	2, 884, 801	418, 627	1, 366, 646
1897	195, 869	87, 992	14, 248, 159	3, 361. 703	2, 597, 886	3, 054, 012	521, 560	1, 336, 380
1898	244, 187	145, 888	16, 700, 999	4, 076, 347	2, 863, 812	3, 406, 555	593, 709	1, 381, 466
1899	233, 111	160, 915	19, 252, 995	4, 776, 224	3, 837, 392	3, 852, 267	786, 049	1, 537, 427
1900	315, 557	171, 708	22, 647, 207	5, 244, 364	4, 014, 602	4, 467, 870	1, 147, 027	1, 922, 298
1901	342, 825	151, 079	24, 068, 402	5, 700, 015	4, 485, 374	4, 900, 528	1, 322, 614	2, 421, 781
1902	414, 083	84, 984	24, 570, 826	7, 401, 343	4, 429, 491	5, 266, 065	1, 574, 521	2, 820, 666
1903	416, 951	104, 673	29, 337, 241	7, 423, 602	4, 635, 293	5, 839, 976	1, 681, 409	3, 517, 388
1904	383, 191	78, 888	32, 406, 752	6, 658, 355	5, 178, 556	6, 333, 307	1, 493, 027	3, 046, 539
1905	351, 991	77, 050	37, 791, 580	8, 826, 429	5, 602, 021	6, 423, 979	1, 332, 372	2, 924, 427
1906	332, 107	25, 290	43, 290, 350	10, 111, 218	6, 133, 994	6, 024, 775	1, 772, 551	2, 860, 200
1907	362, 401	13, 950	48, 091, 583	10, 790, 236	6, 252, 990	7, 322, 449	1, 947, 607	3, 642, 658
1908	264, 822	18, 755	41, 897, 843	9, 634, 973	5, 489, 902	6, 245, 508	1, 846, 792	2, 948, 116
1909	211. 196	45, 836	51, 849, 220	10, 716, 936	6, 393, 109	6, 986, 478	2, 266, 899	3, 119, 377
1910	177, 245	11, 164	61, 671, 019	11, 973, 736	7, 533, 088	4, 921, 451	2, 517, 809	2, 646, 226
1911	165, 210	10, 747	59, 831, 580	10, 157, 383	6, 744, 864	6, 178, 728	2, 513, 175	3, 074, 242
1912	227, 503	10, 978	66, 786, 687	10, 977, 824	7, 368, 124	6, 986, 182	3, 016, 149	3, 675, 418
1913	255. 626	24, 839	71, 254, 136	9, 232, 510	7, 393, 066	7, 202. 210	3, 254, 828	4, 165, 770
1914	166, 498	([a])	71, 707, 626	8, 170, 559	6, 475, 293	6, 860, 988	3, 103, 036	3, 988, 613
1915	134, 496	([a])	77, 184, 069	8, 624, 980	6, 554, 028	6, 824, 474	3, 108, 715	3, 693, 580
1916	173, 554	([a])	86, 460, 127	10, 484, 237	7, 910, 647	6, 881, 455	3, 567, 428	3, 608, 011
1917	119, 028	([a])	86, 441, 667	12, 483, 336	8, 575, 619	7, 184, 975	4, 125, 230	4, 386, 844
1918	66, 716	([a])	89, 935, 839	12, 407, 571	9, 438, 688	7, 561, 947	5, 136, 825	4, 813, 447
1919	53, 337	([a])	79, 036, 553	10, 323, 420	7, 219, 738	5, 224, 724	4, 631, 323	3, 802, 113
1920	50, 156	([a])	89, 970, 707	12, 278, 225	9, 630, 271	5, 926, 408	6, 005, 199	4, 849, 288
1921	33, 815	([a])	72, 786, 996	9, 122, 760	7, 200, 666	[b]3, 466, 641	4, 078, 784	3, 362, 623
1922	60, 636	([a])	80, 488, 192	10, 019, 597	5, 971, 724	[b]2, 955, 170	4, 992, 008	2, 802, 511
1923	75, 620	([a])	107, 899, 941	10, 346, 218	7, 575, 031	4, 443, 149	4, 720, 217	2, 885, 038
	10, 359, 154	[c]5, 153, 264	1, 629, 400, 741	279, 622, 601	195, 292, 623	187, 026, 692	77, 721, 599	97, 666, 232

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[a] Included under "Miscellaneous."

[b] Figures for 1921 and 1922 are incomplete. State Coal Mine Inspection Department reports 4,028,624 tons in 1921 and 3,518,243 tons in 1922.

[c] Total through 1913.

TABLE 22.—*Coal produced, 1807–1923, in net tons*—Continued

Year	Oregon	Montana	New Mexico	Texas	North Dakota	Miscellaneous [d]	Total bituminous	Grand total
1807–1820							3, 000	15, 000
1821								1, 322
1822							54, 000	58, 583
1823							60, 000	68, 563
1824							67, 040	80, 725
1825							75, 000	117, 988
1826							88, 720	147, 914
1827							94, 000	172, 151
1828							100, 408	195, 908
1829							102, 000	240, 086
1830							104, 800	320, 072
1831							120, 100	337, 942
1832							146, 500	594, 050
1833							133, 750	734, 657
1834							136, 500	600, 515
1835							134, 000	824, 854
1836							142, 000	984, 832
1837							182, 500	1, 253, 651
1838							445, 452	1, 355, 527
1839							552, 038	1, 560, 360
1840						1, 520	1, 102, 931	2, 070, 039
1841							1, 108, 700	2, 291, 141
1842							1, 244, 494	2, 610, 057
1843							1, 504, 121	3, 060, 874
1844							1, 672, 045	3, 681, 252
1845							1, 829, 872	4, 309, 904
1846							1, 977, 707	4, 865, 522
1847							1, 735, 062	5, 286, 067
1848							1, 968, 032	5, 773, 974
1849							2, 453, 497	6, 448, 831
1850							2, 880, 017	7, 018, 181
1851							3, 253, 460	8, 734, 525
1852							3, 664, 707	9, 816, 664
1853							4, 169, 862	10, 570, 288
1854							4, 582, 227	11, 977, 102
1855							4, 784, 919	12, 926, 673
1856							5, 012, 146	13, 546, 925
1857							5, 153, 622	13, 340, 189
1858							5, 548, 376	13, 974, 478
1859							6, 013, 404	15, 633, 175
1860						3, 800	6, 494, 200	14, 610, 042
1861							6, 688, 358	16, 488, 012
1862							7, 790, 725	17, 485, 835
1863							9, 533, 742	21, 319, 062
1864							11, 066, 474	23, 605, 123
1865							11, 900, 427	23, 792, 173
1866							13, 352, 400	29, 003, 583
1867							14, 722, 313	30, 724, 422
1868							15, 858, 555	32, 861, 960
1869							15, 821, 226	32, 904, 360
1870						1, 425	17, 371, 305	33, 035, 580
1871						5, 629, 869	27, 543, 023	46, 885, 080
1872						176, 159	27, 220, 233	51, 453, 399
1873						1, 939, 567	31, 449, 643	57, 602, 480
1874							27, 787, 130	52, 605, 920
1875						40, 000	29, 862, 554	52, 348, 320
1876						366, 875	30, 486, 755	53, 280, 000
1877						1, 056, 734	34, 841, 444	60, 501, 760
1878						374, 744	36, 245, 918	57, 935, 600
1879							37, 898, 006	68, 105, 799
1880	43, 205	224				200	42, 831, 758	71, 481, 570
1881	33, 600	5, 000	21, 000			76, 900	53, 961, 012	85, 881, 030
1882	35, 000	10, 000	157, 092			6, 502, 359	68, 429, 933	103, 551, 189
1883	40, 000	19, 795	211, 347			6, 870, 075	77, 250, 680	115, 707, 525
1884	45, 000	80, 376	220, 557	125, 000	35, 000	9, 498, 174	82, 998, 704	120, 155, 551
1885	50, 000	86, 440	306, 202	100, 000	25, 000		72, 824, 321	111, 160, 295
1886	45, 000	49, 846	271, 285	100, 000	25, 955	794, 917	74, 644, 981	113, 680, 427
1887	37, 696	10, 202	508, 034	75, 000	21, 470	1, 237, 195	88, 562, 314	130, 650, 511
1888	75, 000	41, 467	626, 665	90, 000	34, 000	4, 257, 907	102, 040, 093	148, 659, 657
1889	64, 359	363, 301	486, 943	128, 216	28, 907	1, 400	95, 682, 543	141, 229, 513
1890	61, 514	517, 477	375, 777	184, 440	30, 000	807	111, 302, 322	157, 770, 963
1891	51, 826	541, 861	462, 328	172, 100	30, 000	2, 000	117, 901, 238	168, 566, 669
1892	34, 661	564, 648	661, 330	245, 690	40, 725	1, 510	126, 856, 567	179, 329, 071
1893	41, 683	892, 309	665, 094	302, 206	49, 630		128, 385, 231	182, 352, 774
1894	47, 521	927, 395	597, 196	420, 848	42, 015	150	118, 820, 405	170, 741, 526

[d] From 1871 to 1888, inclusive, production reported in this column is due principally to colliery consumption, which in some years was estimated and not included in the distribution by States. Since 1888 small, irregular production from several unimportant sources has been included in this column.

TABLE 22.—*Coal produced, 1807–1923, in net tons*—Continued

Year	Oregon	Montana	New Mexico	Texas	North Dakota	Miscellaneous	Total bituminous	Grand total
1895	73, 685	1, 504, 193	720, 654	484, 959	38, 997	200	135, 118, 193	193, 117, 530
1896	101, 721	1, 543, 445	622, 626	544, 015	78, 050	18, 792	137, 640, 276	191, 986, 357
1897	107, 289	1, 647, 882	716, 981	639, 341	77, 246	18, 565	147, 617, 519	200, 229, 199
1898	58, 184	1, 479, 803	992, 288	686, 734	83, 895	17, 039	166, 593, 623	219, 976, 267
1899	86, 888	1, 496, 451	1, 050, 714	883, 832	98, 809	1, 277	193, 323, 187	253, 741, 192
1900	58, 864	1, 661, 775	1, 299, 299	968, 373	129, 883	1, 210	212, 316, 112	269, 684, 027
1901	69, 011	1, 396, 081	1, 086, 546	1, 107, 953	166, 601	1, 300	225, 828, 149	293, 299, 816
1902	65, 648	1, 560, 823	1, 048, 763	901, 912	226, 511	4, 242	260, 216, 844	301, 590, 439
1903	91, 144	1, 488, 810	1, 541, 781	926, 759	278, 645	4, 997	282, 749, 348	357, 356, 416
1904	111, 540	1, 358, 919	1, 452, 325	1, 195, 944	271, 928	4, 174	278, 659, 689	351, 816, 398
1905	109, 641	1, 643, 832	1, 649, 933	1, 200, 684	317, 542	9, 656	315, 062, 785	392, 722, 635
1906	79, 731	1, 829, 921	1, 964, 713	1, 312, 873	305, 689	11, 706	342, 874, 867	414, 157, 278
1907	70, 981	2, 016, 857	2, 628, 959	1, 648, 069	347, 760	17, 727	394, 759, 112	480, 363, 424
1908	86, 259	1, 920, 190	2, 467, 937	1, 895, 377	320, 742	8, 586	332, 573, 944	415, 842, 698
1909	87, 276	2, 553, 940	2, 801, 128	1, 824, 440	422, 047	7, 353	379, 744, 257	460, 814, 616
1910	67, 533	2, 920, 970	3, 508, 321	1, 892, 176	399, 041	5, 448	417, 111, 142	501, 596, 378
1911	46, 661	2, 976, 358	3, 148, 158	1, 974, 593	502, 628	2, 721	405, 907, 059	496, 371, 126
1912	41, 637	3, 048, 495	3, 536, 824	2, 188, 612	499, 480	3, 319	450, 104, 982	534, 466, 580
1913	46, 063	3, 240, 973	3, 708, 806	2, 429, 144	495, 320	14, 789	478, 435, 297	569, 960, 219
1914	51, 558	2, 805, 173	3, 877, 689	2, 323, 773	506, 685	25, 824	422, 703, 970	513, 525, 477
1915	39, 231	2, 789, 755	3, 817, 940	2, 088, 908	528, 078	24, 496	442, 624, 426	531, 619, 487
1916	42, 592	3, 632, 527	3, 793, 011	1, 987, 503	634, 912	29, 199	502, 519, 682	590, 098, 175
1917	28, 327	4, 226, 689	4, 000, 527	2, 355, 815	790, 548	68, 420	551, 790, 563	651, 402, 374
1918	13, 328	4, 532, 505	4, 023, 239	2, 261, 135	719, 733	89, 948	579, 385, 820	678, 211, 904
1919	18, 739	3, 236, 369	3, 138, 756	1, 680, 656	840, 959	81, 645	465, 860, 058	553, 952, 259
1920	20, 717	4, 413, 866	3, 683, 440	1, 615, 015	948, 625	76, 641	568, 666, 683	658, 264, 932
1921	(a)	2, 733, 958	2, 453, 482	972, 839	864, 903	123, 215	415, 921, 950	506, 395, 401
1922	(a)	2, 572, 221	3, 147, 173	1, 106, 007	1, 327, 564	113, 920	422, 268, 099	476, 951, 121
1923	(a)	3, 147, 678	2, 915, 173	1, 187, 329	1, 385, 400	150, 271	564, 564, 662	657, 903, 671
	[e]2, 380, 313	75, 490, 800	76, 368, 036	44, 228, 270	13, 970, 923	39, 770, 967	12, 333, 769, 840	15, 662, 484, 738

[a] Included under "Miscellaneous."
[e] Total through 1920.

STATISTICS OF LABOR

METHOD OF COLLECTING STATISTICS

The statistics of number of men employed presented in this report are based on the replies of operators to the following questions:

Average number of men employed during year:
  Underground—
    Miners (hand or machine), loaders, and shot firers.
    All other underground workers..................
  Surface (excluding coke and office workers)...........

Total number employed......................

It is not always easy for the mine operator to determine accurately "the average number of men employed." The ideal method, where the records available permit, would be to ascertain the total number of shifts or man-days of labor during the year and divide this number by the number of days the mine worked. Now the number of man-days of day workers—that is, men paid by the day—can be ascertained from the mine pay roll, but to get the man-days of the tonnage workers—the men paid by the piece—would require special records, which are maintained by few bituminous operators at the present time. At most bituminous mines no record is kept of the hours spent underground by the tonnage men, and the only evidence that a pick miner or loader had worked at all on a given day would be the presence of his check number on the weigh sheet, or possibly an entry in the foreman's attendance book. The lack of such a statement of the time worked by tonnage men is a serious handicap to the collection of accurate statistics of earnings, accident rates, volume of employment, attendance, and the productivity of labor and efficiency of management. That the difficulties in the way of keeping such a record are not insuperable is shown from the fact that it is made a regular part of the system of determining costs, owners' profits, and miners' wage rates now in effect in the coal-mining industry of Great Britain. The installation of such a record, developed on a plan that can be applied under American conditions of mining, is urged upon both employers and employees. Until it can be provided, measurements of all factors that involve the amount of labor expended will remain crude and subject to serious error.

In the absence of information on the number of man-shifts worked, many operators calculate the average number employed by averaging the numbers on the several pay rolls during the year. This method involves double counting to the extent that the same employees appear on the pay rolls of two or more mines in the same pay period—that is, duplication is introduced in proportion to the rapidity of labor turnover. Important as turnover may be in studies of labor relations and labor efficiency, it does not appear that the duplication introduced by it seriously impairs the value of the figures showing numbers employed. At a mine that works steadily during the year the average of the 24 semimonthly pay rolls will give a fairly accurate measure of the number employed. Where this method is used pay-roll periods should not be included in which, because of a strike that lasts throughout the pay period or because of idleness through lack of market, the number of men drawing pay is only a small fraction of the normal working force. To include such a pay-roll period would artificially cut down the average number of men dependent for employment upon the mine, and it is clear from the returns that operators do not include such periods in calculating the average.

Many of the smaller operators do not even average the pay rolls for the year but rather set down the number of employees shown by the last pay roll.

Careful study of the returns under the diverse conditions of the five years ending in 1923 indicates that the figures reported do not represent the average number of men actually at work at any one moment, nor the aggregate number of men who have worked at the mine during the year, nor the precise average number of men on the pay rolls, but rather the number of men commonly dependent on the mines for employment. They represent the number ordinarily reporting for work when the mine starts, plus the absentees—the men who have been working recently and will work again but who for one reason or another are not on hand that day. The totals for districts and for the United States are, therefore, a fair measure of the total number of coal-mine workers. These statistics are not accurate in all details, but they are comparable from year to year for each unit of the industry and represent the most accurate returns obtainable under present conditions, both as to the records generally available in mine offices and as to the funds allotted to the Geological Survey for their collection.

TOTAL NUMBER OF EMPLOYEES

In spite of the admitted irregularity of employment in the bituminous-coal mines, the number of mine workers has continued to increase. From 640,000 in 1920 the number on the rolls rose to 664,000 in 1921, 688,000 in 1922, and 705,000 in 1923. From 1920 to 1923 the increase for the country as a whole amounted to 10.2 per cent (Table 23), but in the several producing States the change has been far from uniform. Plate VII brings out the fact that in the trans-Mississippi States, except New Mexico and North Dakota, the number employed has declined. In the States east of the Mississippi it has declined in the outlying districts of Michigan, Maryland, and Tennessee and has increased in the central field and its southern competitors, Kentucky and West Virginia. The sharpest increase, 23 per cent, was in Kentucky. Alabama also has shown an increase.

This increase in numbers employed would appear to indicate that during this period the conditions of employment offered by the soft-coal mines were preferred by large numbers of men to any other work available to them. It is the more noteworthy, especially in the union States of the Central Competitive Field, because during the same period there was no increase in output

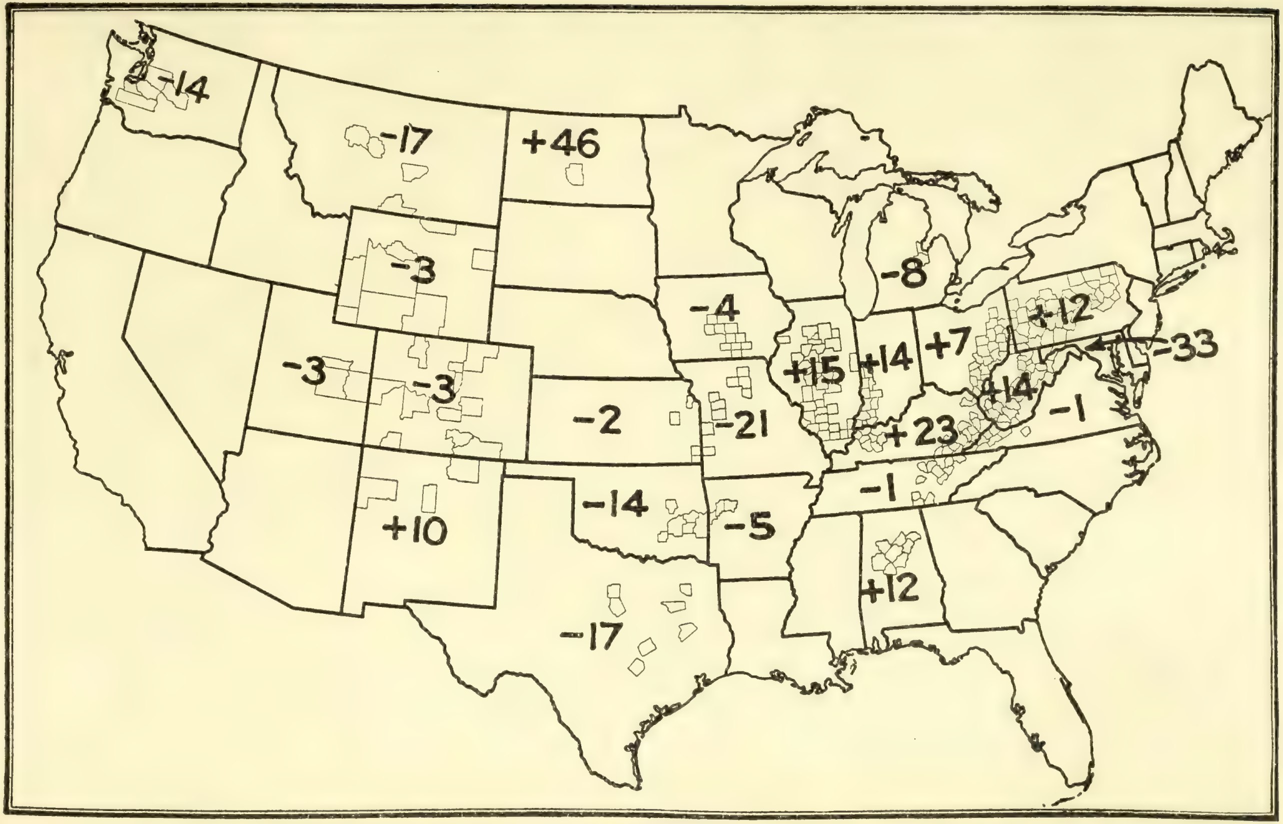
TABLE 23.—*Number of employees in bituminous-coal mines, 1920, 1922, and 1923*

State	Average number employed			Increase or decrease (per cent)	
	1920	1922	1923	1920 to 1923	1922 to 1923
Alabama	[a] 25, 540	28, 169	30, 035	[a]+17. 6	+6. 6
Arkansas	3, 966	4, 035	3, 754	−5. 3	−7. 0
Colorado	13, 711	13, 506	13, 340	−2. 7	−1. 2
Illinois	87, 084	96, 336	99, 714	+14. 5	+3. 5
Indiana	31, 155	33, 208	35, 408	+13. 7	+6. 6
Iowa	11, 905	12, 857	11, 448	−4. 0	−12. 3
Kansas	[b] 8, 984	[b] 7, 359	9, 761	([b])	([b])
Kentucky	49, 452	60, 924	60, 811	+23. 0	−. 2
Maryland	5, 548	3, 755	3, 725	−32. 9	−. 8
Michigan	2, 154	2, 166	1, 977	−8. 2	−8. 7
Missouri	8, 838	8, 750	6, 952	−21. 3	−20. 5
Montana	4, 204	3, 635	3, 511	−16. 5	−3. 4
New Mexico	3, 738	4, 001	4, 095	+9. 6	+2. 3
North Dakota	1, 110	1, 648	1, 621	+46. 0	−1. 6
Ohio	50, 857	54, 194	54, 555	+7. 3	+. 7
Oklahoma	8, 244	7, 828	7, 130	−13. 5	−8. 9
Pennsylvania (bituminous)	173, 970	188, 838	194, 981	+12. 1	+3. 3
Tennessee	11, 353	11, 449	11, 244	−1. 0	−1. 8
Texas	2, 950	2, 841	2, 452	−16. 9	−13. 7
Utah	4, 504	4, 721	4, 381	−2. 7	−7. 2
Virginia	14, 010	13, 399	14, 120	+. 8	+5. 4
Washington	4, 994	4, 481	4, 306	−13. 8	−3. 9
West Virginia	102, 950	110, 014	117, 300	+13. 9	+6. 6
Wyoming	7, 779	9, 045	7, 529	−3. 2	−16. 8
Other States [c]	547	799	643	+17. 6	−19. 5
Total bituminous	639, 547	687, 958	704, 793	+10. 2	+2. 4
Pennsylvania anthracite	145, 074	156, 849	157, 743	+8. 7	+. 6
Grand total	784, 621	844, 807	862, 536	+9. 9	+2. 1

[a] Because of the strike in Alabama in 1920, that year is not a fair standard of comparison. Against 1919, when the average number employed was 26,874, the year 1923 shows an increase of 11.8 per cent.

[b] Figures for Kansas in 1920 and 1922 are probably incomplete. In comparison with 1919, when 9,926 men were employed, the year 1923 shows a decrease of 1.7 per cent.

[c] Includes Alaska, California, Georgia, Idaho, Oregon, North Carolina, and South Dakota.



PERCENTAGE CHANGES IN NUMBER OF MEN EMPLOYED, 1920 TO 1923

The figure for Alabama is the increase from 1919 to 1923, used because a strike in 1920 makes that year an unfair standard of comparison. The figure for Kansas is also the change from 1919 to 1923

CLASSIFICATION OF MINE EMPLOYEES

The employees engaged in coal mining fall into two groups. One group includes those who are directly engaged in winning the coal and who are paid by the piece at so much a ton. They are known collectively as "tonnage men," or often as "contract men," because each piece worker in a sense is a contractor, obligating himself to get out coal and maintain his working place at a fixed rate of compensation. The tonnage men work underground.

The men in the other group are known collectively as "day men," or sometimes as "company men." They are paid by the day. Their duties are concerned with the maintenance of the mine, with construction and repair work, with the operation of haulage and ventilation systems and the pumps, hoists, and power house, and with the work at the tipple, where the coal is dumped from mine car to railroad car and often cleaned, picked, or sized. The day men are classified as "inside" and "outside" men, according as they work underground or on the surface.

In the anthracite region the terms "company men" and "contract men" are commonly applied to the two groups, and in the bituminous fields, though usage varies widely, the terms "tonnage men" and "day men" are perhaps most frequently used.

There are exceptions to the statement that the men engaged directly in winning the coal are piece workers and that all others are paid according to time, for piece rates are sometimes applied to other tasks, and again men may be placed on the day roll while engaged in mining a bit of difficult coal where their tonnage rate would not yield a living wage. Broadly, however, the distinction holds.

To get approximate figures of the number of tonnage men, the Geological Survey has since 1920 asked operators to report the number of "miners, hand or machine, loaders, and shot firers." This grouping would include pick miners, loaders after machines, and operators of the cutting machines themselves, also the small group of shot firers who are commonly paid by the piece and who perform, in the districts where they are employed, a task that elsewhere is a part of the work of the miner himself. The classification "all other workers underground" is practically equivalent to the inside day men. The outside men are, with rare exceptions, all time workers, though some are paid by the month rather than the day.

TONNAGE AND DAY MEN INSIDE AND OUTSIDE

It has not been possible up to the present to collect complete statistics for the country of the numbers in each occupation at the mines, partly because of the great diversity in occupational classification from field to field, and partly because of the expense involved. Indeed, up to 1916 the only statistics of men employed collected by the Geological Survey were the total number. In 1916, a division was made for the first time between underground and surface workers, and it was not until 1920 that the underground workers were further subdivided into tonnage men and day men. Thanks to the zeal of Mr. W. W. Adams, accident statistician of the United States Bureau of Mines, the division into underground surface workers has been carried back to 1911, partly by reference to State reports and to returns received by the bureau and partly by estimate.

Those who seek more detailed records by occupations will find them in certain of the statements in mine inspectors' reports, in studies of the United States Coal Commission, and in the periodic investigations of wages and hours worked by the Federal Bureau of Labor Statistics. Unfortunately all these records are incomplete—either, as in the case of the statements of the mine inspectors, because they cover only part of the country, or because they relate to only a sample list of mines.

The results of the classification into underground and surface employees appear in summary form in Table 24. The figures for bituminous coal reveal a notable shift in the relative proportion of underground and surface men during and since the war. In 1916 84.5 per cent of the total number employed worked underground. In 1918 the proportion had dropped to 80.7 per cent, and since then it has steadily increased, rising to 81.8 per cent in 1919 and 82.8 per cent in 1920. For the last three years it has averaged about 85 per cent. The chief element in the increasing proportion of underground workers is the increase in the proportion of tonnage men. In 1920, when the classification between tonnage men and day men underground was first made, the percentage classified as "miners, loaders, and shot firers" was 55.5. In 1921 it rose to 60.1 per cent, and though slightly less in 1922 and 1923 it remains close to 60 per cent of the total number employed. The number of "other underground workers"—that is, the day men—has decreased in relative importance as the number of tonnage workers increased. In 1920 the percentage of underground day men to the total employed was 27.3, and for the three years 1921 to 1923 it has been constant at about 25 per cent.

The change in the percentage of underground workers has a complement, of course, in the changing percentage of surface workers. In 1916 15.5 per cent of the bituminous employees worked outside. The relative proportion increased to 19.3 per cent in the peak of the war activity, since when it has declined, reaching 14.9 per cent in 1923.

In the anthracite region changes closely parallel to those in the bituminous-coal fields occurred during the period in the relative proportions of underground and surface employees. Owing to the much greater labor involved in preparing anthracite for the market the percentage of outside workers is larger than in bituminous-coal mining. In the anthracite region from 27 to 30 per cent of the employees work outside, as against about 15 per cent in the bituminous-coal fields, but in anthracite as in bituminous-coal mining the war brought about a decrease in the relative proportion of underground workers and a corresponding increase of outside employees. From 73 per cent of the total in 1916 the proportion of underground men dropped to 69.1 per cent in 1918. Since the war the developments in the anthracite region, as in the bituminous-coal fields, have been in the direction of restoring the proportions of underground and surface workers that formerly prevailed. From 1919 on the percentage of underground workers tended to increase, reaching in the three years 1921–1923 a level of about 73 per cent.

The causes of these changes are found in the state of the labor market, particularly the shortage that resulted from the demands of the munitions industry and the drafting of men for military service, and in the state of the coal market. High prices of coal stimulate development work and the opening of new mines and tend to increase the proportion of day men, both underground and on the surface. In the period from 1917 to 1920, when for the greater part of the time transportation rather than demand was the factor limiting production, every bituminous-coal operator was eager to increase his railroad rating and thereby increase his share of the available cars. Men were added to the roll if it was felt that any increase in hourly productivity would result, though then as later the mines were working far from full time. In the competition to hire labor it was easier to get men for the day positions than for the more skilled tonnage work. With the reversal of the market in 1921, however, there was a tendency to transfer employees from the day to the tonnage scale, because when paid by the piece the man's wages became a charge upon costs only in proportion to the coal he produced. An important factor in the anthracite region was the great activity in washing culm-bank coal during the period of high prices, an operation which of course tended to increase the number of surface workers.

TABLE 24.—*Men employed underground and on the surface in coal mines, 1911–1923*

Year	Underground						Surface		Total	
	Miners, loaders, etc.		All others		Total underground					
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Anthracite:										
1911	(a)	(a)	(a)	(a)	[b] 126,541	72.7	[b] 47,399	27.3	[b] 173,940	100.0
1912	(a)	(a)	(a)	(a)	[c] 126,606	72.7	[c] 47,424	27.3	174,030	100.0
1913	(a)	(a)	(a)	(a)	[c] 127,854	72.7	[c] 47,891	27.3	175,745	100.0
1914	(a)	(a)	(a)	(a)	133,309	74.2	46,370	25.8	179,679	100.0
1915	(a)	(a)	(a)	(a)	130,963	74.2	45,589	25.8	176,552	100.0
1916	(a)	(a)	(a)	(a)	116,705	73.0	43,164	27.0	159,869	100.0
1917	(a)	(a)	(a)	(a)	109,989	71.3	44,185	28.7	154,174	100.0
1918	(a)	(a)	(a)	(a)	101,671	69.1	45,450	30.9	147,121	100.0
1919	(a)	(a)	(a)	(a)	107,829	69.8	46,742	30.2	154,571	100.0
1920	63,339	43.6	37,684	26.1	101,023	69.7	44,051	30.3	145,074	100.0
1921	73,977	46.4	42,840	26.8	116,817	73.2	42,682	26.8	159,499	100.0
1922	72,527	46.2	41,752	26.6	114,279	72.8	42,570	27.2	156,849	100.0
1923	72,362	45.9	42,359	26.8	114,721	72.7	43,022	27.3	157,743	100.0
Bituminous:										
1911	(a)	(a)	(a)	(a)	[b] 479,294	86.5	[b] 75,114	13.5	[b] 554,408	100.0
1912	(a)	(a)	(a)	(a)	[c] 474,513	86.5	[c] 74,119	13.5	548,632	100.0
1913	(a)	(a)	(a)	(a)	[c] 494,238	86.4	[c] 77,644	13.6	571,882	100.0
1914	(a)	(a)	(a)	(a)	506,025	86.7	77,481	13.3	583,506	100.0
1915	(a)	(a)	(a)	(a)	482,433	86.5	75,023	13.5	557,456	100.0
1916	(a)	(a)	(a)	(a)	474,244	84.5	86,858	15.5	561,102	100.0
1917	(a)	(a)	(a)	(a)	498,185	82.6	104,958	17.4	603,143	100.0
1918	(a)	(a)	(a)	(a)	496,252	80.7	119,053	19.3	615,305	100.0
1919	(a)	(a)	(a)	(a)	508,801	81.8	113,197	18.2	621,998	100.0
1920	355,660	55.5	174,152	27.3	529,812	82.8	109,735	17.2	639,547	100.0
1921	399,270	60.1	168,019	25.4	567,289	85.5	96,465	14.5	663,754	100.0
1922	407,772	59.3	174,637	25.3	582,409	84.6	105,549	15.4	687,958	100.0
1923	422,040	59.9	178,265	25.3	600,305	85.2	104,488	14.8	704,793	100.0

[a] No data.

[b] In 1911 the Bureau of Mines made a special inquiry in connection with its accident statistics, the results of which are here shown. The totals obtained by the Geological Survey in that same year were 172,585 for anthracite and 549,775 for bituminous coal mines.

[c] Estimated by the Bureau of Mines.

RELATIVE PROPORTION OF TONNAGE AND DAY MEN BY STATES

There is a wide variation in the ratio of tonnage and day men in different States and under different conditions of mining. The percentage of tonnage men ranged in 1923 all the way from 48.2 in Virginia to 71.4 in Kansas. The contrasts disclosed by Table 25 are due in part to differences in the size and age of the mines, in part to differences in methods of preparing the coal for market, and in part to the use of mining machines and to differences in the percentage of the coal in the ground that is extracted in the operation of mining. Other things being equal, an old mine will have a larger percentage of daymen than one in its prime because of the increasing length of haulage ways which have to be kept in repair and the increasing distance that each ton of coal must be transported from the face to the tipple. Other things being equal also, the art of mining, like other arts, tends toward greater and greater division of labor, and this tendency in turn acts to decrease the proportion of tonnage men and to increase the number of specialists who serve the tonnage men in some way. Not the least significant of the causes of the variation shown are differences in the system of payment under which a task regarded as piecework in one district may elsewhere be considered as time-work.

The percentages are based upon the total number of men engaged in working coal in each State and include the employees in stripping mines. Where stripping is exceptionally common, this fact would tend to increase the percentage of outside men unduly and to decrease proportionally both of the inside classes. It is not believed, however, that this is a material factor in explaining the differences.

Districts like Alabama and Washington, where much of the output is washed, tend to show a higher percentage of surface workers.

Conspicuous among the States in which the proportion of tonnage men underground is high and the proportion of day men low—are those of the Middle West and Southwest. On the other hand, the nonunion States of the middle Appalachians, whose output has increased so rapidly in recent years, are conspicuous for a low percentage of tonnage men. Here are found Kentucky, West Virginia, and Virginia.

No important union State shows as small a percentage of tonnage employees as the anthracite region. For the bituminous-coal fields as a whole 59.8 per cent of the men are engaged directly in the business of winning coal; in anthracite mining the ratio is 45.9 per cent.

TABLE 25.—*Men employed in coal mines, 1922–23*

State	Underground				Surface		Total
	Miners [a]		All others		Number	Percentage	
	Number	Percentage	Number	Percentage			
1922							
Alabama	16,615	59.0	6,528	23.2	5,026	17.8	28,169
Alaska	149	34.7	113	26.2	168	39.1	430
Arkansas	2,386	59.1	973	24.1	676	16.8	4,035
California, Idaho, and Oregon	20	33.3	25	41.7	15	25.0	60
Colorado	7,911	58.6	3,158	23.4	2,437	18.0	13,506
Georgia	68	45.4	23	15.3	59	39.3	150
Illinois	61,592	63.9	24,704	25.7	10,040	10.4	96,336
Indiana	20,605	62.0	8,288	25.0	4,315	13.0	33,208
Iowa	8,369	65.1	3,477	27.0	1,011	7.9	12,857
Kansas	5,093	69.2	1,319	17.9	947	12.9	7,359
Kentucky	34,189	56.1	16,207	26.6	10,528	17.3	60,924
Maryland	2,563	68.3	663	17.6	529	14.1	3,755
Michigan	1,335	61.6	639	29.5	192	8.9	2,166
Missouri	5,370	61.4	1,848	21.1	1,532	17.5	8,750
Montana	2,194	60.3	904	24.9	537	14.8	3,635
New Mexico	2,253	56.3	969	24.2	779	19.5	4,001
North Carolina	50	39.4	45	35.4	32	25.2	127
North Dakota	846	51.3	290	17.6	512	31.1	1,648
Ohio	34,134	62.9	11,772	21.8	8,288	15.3	54,194
Oklahoma	4,390	56.1	2,234	28.5	1,204	15.4	7,828
Pennsylvania (bituminous)	114,541	60.6	44,910	23.8	29,387	15.6	188,838
South Dakota	32	100.0	----------	----------	----------	----------	32
Tennessee	6,996	61.1	2,537	22.2	1,916	16.7	11,449
Texas	1,994	70.1	541	19.1	306	10.8	2,841
Utah	2,302	48.8	1,327	28.1	1,092	23.1	4,721
Virginia	6,290	46.9	4,567	34.1	2,542	19.0	13,399
Washington	2,434	54.3	1,170	26.1	877	19.6	4,481
West Virginia	57,785	52.5	33,029	30.0	19,200	17.5	110,014
Wyoming	5,266	58.2	2,377	26.3	1,402	15.5	9,045
Total bituminous	407,772	59.3	174,637	25.3	105,549	15.4	687,958
Pennsylvania anthracite	72,527	46.2	41,752	26.6	42,570	27.2	156,849
Grand total	480,299	56.9	216,389	25.6	148,119	17.5	844,807
1923							
Alabama	17,304	57.6	7,330	24.4	5,401	18.0	30,035
Alaska	73	36.7	48	24.1	78	39.2	199
Arkansas	2,124	56.6	846	22.6	784	20.8	3,754
California, Idaho, and Oregon	43	46.3	26	27.9	24	25.8	93
Colorado	8,064	60.5	3,114	23.3	2,162	16.2	13,340
Georgia	69	41.3	23	13.8	75	44.9	167
Illinois	64,194	64.3	24,900	25.0	10,620	10.7	99,714
Indiana	22,777	64.3	8,228	23.2	4,403	12.5	35,408
Iowa	7,797	68.1	2,709	23.7	942	8.2	11,448
Kansas	6,966	71.4	1,662	17.0	1,133	11.6	9,761
Kentucky	33,911	55.8	16,546	27.2	10,354	17.0	60,811
Maryland	2,360	63.4	814	21.8	551	14.8	3,725
Michigan	1,213	61.4	580	29.3	184	9.3	1,977
Missouri	4,217	60.7	1,335	19.2	1,400	20.1	6,952
Montana	2,054	58.5	910	25.9	547	15.6	3,511
New Mexico	2,522	61.6	1,025	25.0	548	13.4	4,095
North Carolina	55	36.7	70	46.7	25	16.6	150
North Dakota	883	54.5	257	15.8	481	29.7	1,621
Ohio	34,121	62.5	12,225	22.4	8,209	15.1	54,555
Oklahoma	4,100	57.5	1,930	27.1	1,100	15.4	7,130
Pennsylvania (bituminous)	120,385	61.7	46,183	23.7	28,413	14.6	194,981
South Dakota	34	100.0	----------	----------	----------	----------	34
Tennessee	6,752	60.0	2,733	24.3	1,759	15.7	11,244
Texas	1,641	66.9	493	20.1	318	13.0	2,452
Utah	2,379	54.3	1,063	24.3	939	21.4	4,381
Virginia	6,810	48.2	4,841	34.3	2,469	17.5	14,120
Washington	2,313	53.7	1,147	26.6	846	19.7	4,306
West Virginia	62,676	53.4	35,207	30.0	19,417	16.6	117,300
Wyoming	4,203	55.9	2,020	26.8	1,306	17.3	7,529
Total bituminous	422,040	59.9	178,265	25.3	104,488	14.8	704,793
Pennsylvania anthracite	72,362	45.9	42,359	26.8	43,022	27.3	157,743
Grand total	494,402	57.3	220,624	25.6	147,510	17.1	862,536

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[a] Includes loaders and shot firers.

DAYS WORKED BY THE MINES

The average number of days worked by the bituminous mines in 1923 was 179. The average time worked in the anthracite region was 268 days.

The base for computing the average number of days worked consists of the replies of operators to the question "Total number of full days mine (tipple) was in operation during the year (parts of days should be reduced to equivalent full days)." The reply for each mine of a district is weighted by the number of men it employs, and the resulting average is taken as the average time worked for that district. The method of weighting is described in the report for 1922. A number of States that collect statistics of mining publish figures of days worked but do not weight them. In the interest of uniformity and accuracy it is urged that all such statistics should be weighted, and the method used by the Survey is recommended as both the simplest and the most accurate.[9]

Failure to weight properly the figures of mine time will understate the amount of employment offered by the industry, because the result will be unduly affected by the small mines, whose average time is considerably below that of the largest operations. Even the weighted average, however, fails to give a true picture of the extraordinary variations in working time from mine to mine. The average is a composite of some mines working as little as 20 or 40 days a year and other mines working full time. In 1920, a year of intensely active demand, the average time worked by all the mines was 220 days, whereas in the same year there were 453 mines that worked 300 days or more, and at the other extreme there were 554 mines that worked less than 100 days. Many factors contribute to this variation in working time. In general, large mines work more steadily than small ones.[10]

All the factors that determine the competitive standing of the mine may influence its working time, including its contracts, its market connections, the quality of its coal, its cost of production, its wage rates, the freight rates that its product must bear to the principal consuming markets, the thickness of its seam, and whether it is operating under a contract with union labor or not. The effects of some of these factors upon the operation of the mines are discussed in the study of the United States Coal Commission entitled "Relief from irregular operation and overdevelopment."[11] The purpose of the present report is not to analyze the causes but to present the statistics of mine operation. In Table 26 are presented for the first time data showing the variation in mine-working time, and consequently in the employment of miners in each of the producing States for the years 1905, 1913, 1914, 1916, 1917, 1918, and 1921.

These figures may be used as a measure of the volume of employment if it is remembered that they represent not the number of days worked by the miners, but the opportunity for employment—that is, the number of days during which the mines were open. There are always a number of men absent even when the mine is working, and to get the number of days worked by the men it would be necessary to deduct the days of absence from the mine time. The amount of this absence, whether voluntary or involuntary, has been studied in the reports of the United States Coal Commission on irregularity of employment and absenteeism, by H. B. Drury.[12] It need not concern us here except to state that the commission found that the average time worked by tonnage men is appreciably less than the time worked by the mines themselves. On the other hand, day men of many classes are employed even when the tipple is not in operation, and for such men the mine time as here shown understates the amount of employment, even if allowance is made for the absenteeism. Table 26 shows, for example, that in 1905 the number of men employed in mines that worked from 200 to 219 days was 17.9 per cent of the total number at work in the bituminous-coal mines of the country. This does not mean that 17.9 per cent of the men actually worked from 200 to 219 days, but that those mines whose time fell within the limits of 200 and 219 days employed, when operating, 17.9 per cent of the total number employed in all mines. If these qualifications are kept in mind the figures may be used safely to indicate the extraordinary range in the opportunity of employment that is offered in typical years by the bituminous-coal industry.

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[9] U. S. Geol. Survey Mineral Resources, 1922, pt. 2, pp. 493–495, 1924.
[10] Idem, pp. 495–496.
[11] U. S. Coal Commission Rept., pp. 193–235, 1925.

In Table 27 is given the average number of days worked for each State from 1913 to 1923.

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[12] U S. Coal Commission Rept., pp. 405–440, 1105–1152.

TABLE 26.—*Men employed in bituminous-coal mines working specified number of days in 1905, 1913, 1914, 1916, 1917, 1918, and 1921, by States*

[From reports by operators to the U. S. Geological Survey. Because of the omission of a few mines and for other reasons, these figures of numbers employed differ slightly from those published elsewhere by the Survey. Note that classification is by mine time and that tonnage men average somewhat less and day men as a group commonly average somewhat more than the mine time]

State	Total number employed in State [a]	Per cent of State total employed in mines working number of days specified															
		Less than 20 days	20 to 39 days	40 to 59 days	60 to 79 days	80 to 99 days	100 to 119 days	120 to 139 days	140 to 159 days	160 to 179 days	180 to 199 days	200 to 219 days	220 to 239 days	240 to 259 days	260 to 279 days	280 to 299 days	300 days and over
1905																	
Alabama	19,814	0.6	0.5		0.6	0.3	0.4	1.1	2.2	3.9	7.6	32.3	13.8	17.9	6.5	9.5	2.8
Alaska	9												77.8			22.2	
Arkansas	4,194	.6	1.1	7.0		.4	2.8	1.0	14.0	15.1	8.6	42.8	1.7	2.8	2.1		
California	135			2.2													97.8
Colorado	11,021		1.2		.5	.1	1.1	1.1	3.0	.4	6.6	17.0	3.8	8.6	10.9	14.2	31.5
Georgia	801													8.7	78.8		12.5
Idaho	37			13.5		16.2	59.5							10.8			
Illinois	58,197	.3	1.3	.5	2.7	1.7	3.7	5.5	4.2	6.3	14.1	21.2	9.5	16.0	8.7	2.8	1.5
Indiana	25,326	.3	1.2	6.9	9.0	15.7	8.1	3.3	5.6	5.1	8.3	20.5	5.2	9.3	.7	.4	.4
Indian Territory	7,714	.2	2.9	.5	.6		2.1	6.4	4.9	14.3	16.4	26.2	23.4	1.9			.2
Iowa	14,996		1.0	.4	3.1	.6	1.9	2.8	6.0	2.7	3.7	22.4	13.6	32.9	7.2	1.2	.5
Kansas	11,927	.6	.2	.4	.1	1.4	1.5	3.5	4.1	6.2	13.8	17.1	25.6	15.3	4.2	1.3	4.7
Kentucky (eastern)	7,479		1.0	.6	.4	.5	2.1	1.3	4.5	6.7	10.1	30.5	14.8	18.8	6.2	1.4	1.1
Kentucky (western)	7,202		.2	1.3		1.7	3.1	6.0	6.3	19.6	8.8	21.7	23.7	5.5	.7		1.4
Maryland	5,949			.1	.4	.6	1.0	1.5		2.4	1.5	7.2	13.6	7.0	51.0	12.1	1.6
Michigan	3,696			5.7		1.5	7.8	2.5	8.9	.8	27.2	6.3	32.9	6.4			
Missouri	8,964		2.6	2.1	.5	1.2	3.1	1.4	4.3	9.8	29.0	16.1	8.0	13.5	5.7	2.1	.6
Montana	2,181				9.1	.9	.3	.2	2.1	.4	1.5	4.2	22.0	4.2	17.2		37.9
New Mexico	2,110	.7						8.3	1.8		16.8	3.0	18.9	5.4	32.2	12.4	.5
North Carolina	15				100.0												
North Dakota	626				1.9	.5	19.2	3.2	6.9	20.6	5.9	15.2	.5	2.1	9.4	3.6	11.0
Ohio	43,391	.3	.6	2.3	3.3	1.5	4.7	7.8	10.0	14.8	16.4	23.1	8.3	4.2	1.5	.5	.7
Oregon	316							4.4			7.9			33.2	53.2		1.3
Pennsylvania	143,554	.5	.8	1.0	1.2	.7	2.1	2.4	3.3	4.9	6.0	12.7	13.2	12.2	16.0	9.2	13.8
Tennessee	11,931		.7	.3	.3	.9	.5	3.3	2.6	6.7	10.9	15.3	17.3	14.9	11.3	8.6	6.4
Texas	3,008	.3					4.2		6.7	2.3		16.4	10.6	21.5		35.9	2.1
Utah	1,361		.2		.2	.4	.4	.4	1.3			.4	55.4	.2	37.6	3.5	
Virginia	5,730		.2			.8	.6	.6	.9	1.0	3.8	11.2	22.1	35.0	3.0	6.5	14.3
Washington	4,766			.5	.1	.1	.1	.7		10.5		39.7		22.3	14.8	5.1	6.1
West Virginia	48,073		.3	.5	.8	1.0	1.6	2.8	10.5	5.5	13.5	16.9	13.1	17.9	7.6	4.7	3.3
Wyoming	5,977			2.0				.6	1.4		2.4	4.5	2.7	20.0	10.5	55.3	.6
	460,500	.3	.8	1.3	1.8	1.7	2.7	3.4	5.1	6.3	10.0	17.9	12.4	13.4	10.0	6.2	6.7

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[a] These figures differ very slightly from those published elsewhere by the Geological Survey.

TABLE 26.—*Men employed in bituminous-coal mines working specified number of days in 1905, 1913, 1914, 1916, 1917, 1918, and 1921, by States*—Continued

State	Total number employed in State	Per cent of State total employed in mines working number of days specified															
		Less than 20 days	20 to 39 days	40 to 59 days	60 to 79 days	80 to 99 days	100 to 119 days	120 to 139 days	140 to 159 days	160 to 179 days	180 to 199 days	200 to 219 days	220 to 239 days	240 to 259 days	260 to 279 days	280 to 299 days	300 days and over
1913																	
Alabama	24,552			0.4	1.4	0.3	1.3	1.6	0.7	1.3	3.8	5.3	9.7	17.1	10.3	24.3	22.5
Arkansas	4,652			2.8	7.3	6.2	2.3	10.1	9.5	4.4	12.5	25.4	15.9	3.6			
Colorado	11,990	0.1	0.1	.9	.6	.5	1.7	6.4	8.4	5.5	6.3	10.0	11.8	7.3	10.5	14.5	15.4
Illinois	79,529	.5	.5	2.5	3.0	2.0	1.9	6.7	4.6	12.0	15.5	16.5	16.0	8.7	7.1	2.3	.2
Indiana	22,235		.2	2.2	1.6	4.7	1.4	4.9	10.2	11.5	10.4	21.8	15.3	9.6	4.9	1.2	.1
Iowa	15,757		1.8	.9	.4	4.3	2.7	3.3	7.8	7.5	12.7	23.7	13.7	10.2	4.9	6.0	.1
Kansas	12,479	.4		2.2	3.3	1.1	2.5	2.3	6.3	1.7	22.5	22.0	19.3	11.7	4.1	.4	.2
Kentucky (eastern)	15,749	1.0	.9	.1	1.1	.8	1.6	1.0	.9	2.9	7.4	22.4	14.1	14.9	17.7	6.7	6.5
Kentucky (western)	10,583		.7		.7	2.8	3.8	3.3	9.2	12.3	28.7	16.3	14.0	5.4	.1	2.7	
Maryland	5,645	.1	.4	1.4		1.6			1.9	2.0	.9	1.7	3.6	3.8	21.6	14.2	46.8
Michigan	3,305		6.1		3.8			10.7	5.7	2.6	4.2	25.3	36.4	.4	4.8		
Missouri	10,418	.8	2.1	4.8	2.5	1.9	3.3	2.1	9.8	7.1	12.1	20.1	14.5	6.1	10.0	1.4	1.4
Montana	3,630			4.5		.1	1.2	1.7	.3	2.7	4.0	14.9	8.9	40.3	19.8	.5	1.1
New Mexico	4,329							.1			1.2	.6	.5	.3	4.7	81.0	11.6
North Dakota	641		.8	1.2	1.6	2.0	2.3	1.7	1.2	1.6	38.6	8.1	.8	4.1	12.2	7.1	16.7
Ohio	45,815	.4	.6	.7	1.2	1.3	2.3	3.2	3.1	6.4	12.8	20.8	28.6	9.8	4.9	2.3	1.6
Oklahoma	9,044		.4	4.5	.1	.8	3.6	7.9	4.1	5.4	22.1	8.4	19.9	12.6	6.5	.7	3.0
Pennsylvania	172,196		.2	.2	.4	.3	.4	.7	.7	.8	1.9	4.2	8.0	11.7	23.2	33.3	14.0
Tennessee	11,238				.6		1.4	1.0	2.8	3.4	4.8	6.5	11.4	39.6	11.5	8.5	8.5
Texas	5,101			2.0						.3	.8	2.8	15.7	31.9	36.9	3.5	6.1
Utah	4,158		.1	.1			.6		1.0		2.2	2.1		27.4	20.0	14.2	32.3
Virginia	9,162				.1				.9			9.8	.3	7.5	7.4	40.8	33.2
Washington	5,794		.1	.5	.5		.6	.9		1.6	.8	10.5	15.4	6.1	27.8	16.6	18.6
West Virginia	74,746	.1	.1	.5	.7	.3	.7	1.1	1.3	3.5	8.5	16.1	16.2	18.6	17.3	9.3	5.7
Wyoming	8,331	.6		.7		1.4	2.2	2.2	.4	3.6	14.9	7.0	6.1	27.7	19.6	7.3	6.3
	571,079	.2	.4	1.0	1.1	1.1	1.2	2.5	2.9	4.5	8.3	12.2	13.4	12.8	14.3	15.6	8.5
1914																	
Alabama	24,052	.7	.2		.9	.6	2.0	3.4	9.0	4.0	7.2	10.5	14.4	8.0	19.1	12.6	7.4
Arkansas	4,340	5.1	5.6	.2	16.5	1.2	4.4	15.9	8.4	4.3	11.3	12.2	6.8	7.4	.5	.2	
California	36												27.8				72.2
Colorado	10,162	.7	2.0		.5	1.5	2.6	1.2	2.7	4.0	4.9	7.7	8.5	14.9	9.1	31.7	8.0
Georgia	355											100.0					
Idaho	4																100.0
Illinois	79,505	.5	1.2	3.5	3.2	4.8	1.9	6.5	9.3	16.4	18.6	12.9	12.1	5.9	2.5	.2	.5
Indiana	23,178		2.0	3.1	7.1	3.4	4.8	6.9	12.7	10.3	16.2	14.6	12.8	5.1	.4	.1	.5
Iowa	16,067		.3	.5	.4	.1	.7	6.2	3.5	9.9	17.5	25.6	15.0	11.6	7.7	.9	.1

Kansas	12,451	.4	1.8	.3	1.5	.4	.4	3.9	3.6	23.4	24.4	11.0	17.0	6.3	3.1	2.5	
Kentucky	28,813	.2	1.6	.5	1.3	1.1	4.5	13.0	10.0	10.1	9.6	15.1	14.6	10.7	5.6	1.2	.9
Maryland	5,405	.3	.3	.8		.3	.9	1.3	4.1	4.3	7.0	19.4	7.9	1.8	3.2	48.4	
Michigan	2,800		3.0			2.9		1.1	7.2	6.1	19.2	32.4	9.1	12.0	7.0		
Missouri	9,550		.6	1.4	6.0	6.2	2.9	4.8	13.0	5.6	8.1	32.7	6.8	8.9	1.5	.9	.6
Montana	3,351	2.0			1.4	.9	3.6	2.0	6.0	14.9	3.8	2.4	39.7	13.2	.4	8.4	1.3
Nevada	3													100.0			
New Mexico	4,180		.1		.1		.1		1.6	1.9		.3	4.7	17.5	1.9	46.9	24.9
North Dakota	559			.4	1.1	.3	.5		1.4	38.6	1.3	14.3	5.5	10.2	5.4	8.8	12.2
Ohio	45,254	.1	9.6	20.9	12.0	3.1	7.7	12.9	18.0	8.0	2.3	.7	1.3	1.1	.5	1.1	.7
Oklahoma	8,080		2.8	.3	1.8	1.6		8.6	3.8	8.2	6.0	8.6	26.7	17.5	13.0		1.1
Oregon	190						1.6			14.2					40.5	11.1	32.6
Pennsylvania	184,788	.1	.3	.3	.9	1.5	3.4	3.1	4.3	7.3	11.0	15.1	21.0	13.6	9.9	6.4	1.8
South Dakota	50	6.0	12.0	8.0		18.0	4.0		4.0	2.0	8.0	8.0	2.0	6.0	22.0		
Tennessee	10,121		.3	2.7	1.6	.3	3.0	.8	2.3	5.4	9.1	21.5	17.2	9.9	12.8	6.2	6.9
Texas	4,642				1.1			1.3	1.1	4.0	2.2	7.8	32.9	22.7	25.0		1.9
Utah	4,112					1.0			10.9	15.0	7.2	32.6	7.5	20.1	1.8		3.9
Virginia	9,185	.6					.6	.2	9.2	4.5	4.9	6.6	15.7	16.9	27.6	8.8	4.4
Washington	5,806	3.0	.4	2.2	1.2	1.6	2.4	4.7	5.7	18.8	11.6	12.3	22.6	.3	6.8	2.2	4.2
West Virginia	79,023		.2	.8	.3	1.7	2.0	4.7	9.4	9.9	16.6	15.8	15.7	11.7	6.8	2.1	2.3
Wyoming	8,118	4.2	.3		.1		2.0	7.2	4.4	11.0	20.0	32.1	2.2	9.6	4.0	2.4	.5
	584,180	.3	1.4	2.6	2.4	2.0	3.0	5.4	7.7	9.5	12.1	14.1	15.3	10.2	7.2	4.8	2.0
1916																	
Alabama	25,308		.7	.2	1.0		.7	1.1	3.0	1.4	2.2	7.3	6.8	13.5	11.5	15.4	35.2
Arkansas	3,772	1.2	.3	2.1	1.0	1.1	9.5	1.1	22.6	4.7	6.3	10.7	26.1	6.4	6.9		
Colorado	13,104	.3	1.1	1.6	.2	1.6	4.0	1.5	2.5	5.4	5.0	13.7	10.7	9.5	11.6	12.6	18.7
Illinois	75,538	.8	1.0	1.5	1.7	1.0	2.1	2.5	5.6	8.1	16.1	24.2	17.6	10.1	6.4	1.0	.3
Indiana	23,965		.7	2.8	1.6	1.4	2.8	4.1	5.4	10.1	24.8	26.7	12.3	5.5	1.2	.5	.1
Iowa	14,443	1.0	.2	.8	4.7	.3	2.2	1.1	4.7	8.6	11.0	23.3	19.9	14.7	2.9	4.6	
Kansas	12,132	.9	.8	1.2	2.3	.2	2.7	3.7	1.3	17.0	11.9	16.0	13.7	12.8	9.3	2.1	4.1
Kentucky (eastern)	20,922	.1	.3	.2	1.3	.2	3.4	1.8	1.9	3.6	8.0	16.0	11.5	14.8	15.3	18.8	2.8
Kentucky (western)	10,310	1.2	3.4	2.6	.3	1.9	20.1	16.2	11.6	4.9	5.7	7.9	11.4	5.2	3.5	1.1	3.0
Maryland	5,633		2.0	.5	.7	.9			.1	.7	.1	7.7	6.9	7.3	38.5	32.6	2.0
Michigan	2,535						1.7		11.5			36.3	21.2	29.3			
Missouri	9,654		1.5	2.7	3.4	5.2	2.6	.6	5.4	7.1	1.6	9.7	17.7	17.5	22.4	.7	1.9
Montana	3,781		.4	.1		3.6	.1	2.0	.2	4.4	6.2	5.9	11.8	14.8	26.8	23.2	.5
New Mexico	4,522					.4	1.0	.5		.2				4.0		46.2	47.7
North Dakota	714				1.7		1.8	.4	.4	1.5	5.3	22.1	.1	10.2	36.7	3.9	15.9
Ohio	41,394	.3	1.2	.8	1.7	2.2	4.3	5.2	2.9	7.3	18.4	16.9	23.2	9.5	1.9	1.7	2.5
Oklahoma	7,800		2.7	1.0	2.0	4.6	2.5	8.9	12.2	7.7	12.6	22.5	10.8	4.6	7.7		.2
Pennsylvania	168,212	.2	.2	.6	.7	.8	.4	.4	.5	1.2	2.2	8.3	10.4	16.6	18.2	14.5	24.8
South Dakota	38		5.3	7.9	10.5		5.3	7.9	18.4	7.9		31.5		5.3			
Tennessee	9,211		1.9	1.4	.2		.5	1.0	1.7	5.4	9.7	10.7	5.1	20.1	12.0	10.5	19.8
Texas	4,481				.9	1.1	.2		1.7	4.1	17.4	11.3	42.0	11.0	10.3		
Utah	3,129		.1				.5	.1	.1		15.4	44.1	15.5	.4	2.4	21.4	
Virginia	9,777		.8			.1			.3	.4	2.4	1.5	8.7	15.3	5.3	52.7	12.5
Washington	4,797	4.1		1.6	2.0	1.0	4.7	.5	2.8	2.7	1.4	15.6	10.2	36.8	11.0	3.1	2.5
West Virginia	78,067	.5	1.1	.6	.2	.2	1.0	1.4	2.4	2.6	8.2	8.8	18.6	17.9	13.7	14.4	8.4
Wyoming	7,255			1.4		.3			.1	2.7	5.0	20.4	20.9	.1	7.3	39.0	2.8
	560,494	.4	.8	.9	1.1	.9	1.9	2.0	2.9	4.3	8.3	13.5	14.2	13.7	11.8	11.1	12.2

TABLE 26.—*Men employed in bituminous-coal mines working specified number of days in 1905, 1913, 1914, 1916, 1917, 1918, and 1921, by States*—Continued

State	Total number employed in State	Per cent of State total employed in mines working number of days specified															
		Less than 20 days	20 to 39 days	40 to 59 days	60 to 79 days	80 to 99 days	100 to 119 days	120 to 139 days	140 to 159 days	160 to 179 days	180 to 199 days	200 to 219 days	220 to 239 days	240 to 259 days	260 to 279 days	280 to 299 days	300 days and over
1917																	
Alabama	27,892	0.4	0.4	1.0	0.1	0.5	1.2	1.0	1.2	1.4	0.7	2.0	3.1	13.2	12.9	14.5	46.4
Arkansas	3,998	.1	1.9	.2	2.3	.2	3.3	8.3	14.8	7.5	8.5	14.3	22.7	15.7	.2		
Alaska	104								6.7						38.5	49.0	5.8
California	12							100.0									
Colorado	14,255	.5	.3	.3	.9	1.0	.6	.7	.9	1.8	4.2	3.8	7.3	10.0	12.6	29.9	25.2
Georgia	275														100.0		
Illinois	84,087	.2	.3	.5	.2	.1	.7	.7	1.9	2.7	5.0	10.3	16.5	19.0	21.1	18.7	2.1
Indiana	26,918		.1	1.3	1.4	1.2	1.1	.3	1.8	3.6	16.4	20.4	11.6	21.2	10.6	7.1	1.9
Iowa	14,122			.6	.3	1.5	.2	.4	.5	2.0	1.0	3.9	9.2	27.4	37.1	13.7	2.2
Kansas	10,279	.1	.1	.5	.9	1.5	1.5	.8	1.9	4.3	9.6	19.5	27.3	14.8	14.6	.4	2.2
Kentucky	34,942	.4	.3	1.3	1.4	1.3	1.6	3.4	4.6	10.0	10.7	12.6	11.7	18.0	15.1	5.6	2.0
Michigan	2,400				3.5		2.6	5.3	.7			1.3		17.9	14.8	53.9	
Missouri	9,577		.4	.9	.1	.3	2.0	1.9	3.1	2.6	6.7	4.3	7.8	14.6	38.3	16.2	.8
Montana	4,149	.1							.3	1.0		13.0	3.4	23.0	13.5	23.1	22.6
Maryland	5,916		.2	.1		.8	.6		1.4	5.4	.1	12.0	8.3	11.1	19.0	37.6	3.4
New Mexico	4,126				.2		.3		1.7	.4	.5		1.7	.7		7.0	87.5
North Dakota	845			.9		.2		.2	3.7	.1	2.4	11.0	2.4	7.7	38.2	13.1	20.1
Oklahoma	8,194		1.1	.6	.5	.3	3.6	4.1	2.9	11.9	4.9	19.6	13.9	22.7	9.2	4.5	.2
Ohio	45,204	.1	.7	.9	1.2	.4	1.1	1.4	3.4	6.0	17.5	21.5	20.2	14.9	5.6	3.1	2.0
Oregon	101										11.9	17.8		2.0	34.6	33.7	
Pennsylvania	174,089	.1	.3	.4	.3	.5	.9	1.1	1.5	2.1	3.2	6.5	5.1	10.6	19.1	32.6	15.7
South Dakota	21	9.5			28.6	14.3	.0		9.5	19.1					9.5		9.5
Tennessee	10,444	.1	.2	1.2	.4	.7	3.5	.8	.5	2.7	11.9	6.0	7.6	22.3	20.3	2.0	19.8
Texas	4,363				.5			.2	.3		1.7	8.3	2.5	36.3	10.1	23.0	17.1
Utah	3,491			1.9		3.7	.1		.3	.1	8.5	28.6	38.1	1.7		17.0	
Virginia	11,168	.1	.1	.2	.3	.7	.5	1.4	2.0	1.3	1.9	2.9	11.0	8.0	2.5	9.3	57.8
Washington	5,312		.2				1.4	.1	3.2	1.4	1.8	1.2	.4	7.4	19.1	60.8	3.0
West Virginia	88,368	.1	.3	.7	.7	1.1	1.5	2.8	4.7	7.3	8.4	13.0	12.7	16.7	11.6	15.3	3.1
Wyoming	7,358	1.6			1.1	.7			5.7	2.5	5.4	10.4	7.4	26.9	5.1	19.7	13.5
	602,010	.2	.3	.6	.6	.7	1.1	1.4	2.5	3.9	6.5	10.3	10.6	15.3	15.8	19.2	11.0
1918																	
Alabama	26,208	.1	.1	.2	.5	.3	1.6	.9	2.0	.3	1.3	2.8	2.6	8.5	13.1	22.8	42.9
Alaska	214					8.9					6.5			4.7	3.7		76.2
Arkansas	3,978	.1	.1	.1	2.1	1.0	5.1	6.1	4.9	3.7	8.5	16.1	29.1	21.7		1.2	.2
California	23								34.8					65.2			
Colorado	14,425			.3	.2	2.2	.5	3.0	4.3	2.9	2.7	7.9	4.9	11.7	12.2	30.8	16.4
Georgia	190						6.3								93.7		
Illinois	85,765	.1	.1			.2	.4	.6	2.2	3.5	7.1	13.5	17.6	23.0	20.2	10.5	1.0
Indiana	30,267	.2	.6	1.3	.8	1.1	1.1	.3	2.3	5.0	9.8	12.2	18.7	19.5	19.7	7.1	.3
Iowa	13,226		.2		.9	.7	.8	.1	1.3	3.1	2.1	4.9	19.0	23.1	29.8	13.5	.5
Kansas	10,654	.2		.6	.7	.6	1.2	4.1	3.8	3.2	2.2	6.0	10.2	32.5	26.0	6.5	2.2
Kentucky	39,309	.2	.2	.5	.5	1.4	1.1	2.6	2.5	4.7	7.6	14.9	9.9	25.3	12.5	10.0	6.1

Maryland	5,553	--------	--------	--------	.6	1.5	.4	--------	.6	2.9	.8	5.9	4.8	22.9	19.1	34.5	6.0
Michigan	2,558	--------	--------	--------	1.4	--------	.5	--------	7.3	3.1	1.3	12.5	11.4	34.4	18.1	10.0	--------
Missouri	9,435	.1	1.0	.6	.8	.3	1.4	4.4	2.8	3.9	2.1	6.3	4.3	26.2	27.2	18.4	.2
Montana	4,541	--------	.3	--------	--------	.1	2.8	.2	.3	--------	--------	6.6	4.7	12.8	34.4	37.3	.5
New Mexico	4,073	--------	--------	--------	--------	--------	1.0	--------	--------	--------	.2	--------	1.5	1.2	1.3	23.0	71.8
North Carolina	50	--------	--------	100.0	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
North Dakota	781	--------	--------	--------	3.8	--------	4.0	5.9	1.9	.5	1.7	13.7	4.5	16.1	39.8	4.5	3.6
Ohio	48,116	.1	.6	.4	.2	.4	.8	1.0	2.3	6.1	8.3	17.5	29.8	17.4	7.9	6.2	1.0
Oklahoma	8,478	--------	--------	.3	2.2	2.1	5.0	2.9	1.0	4.0	3.8	7.0	12.3	31.7	10.5	12.4	4.8
Oregon	40	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	100.0	--------
Pennsylvania	174,123	--------	--------	.3	.3	.1	.6	.7	1.1	1.1	1.4	3.1	7.0	11.4	20.7	37.4	14.8
Tennessee	10,694	.1	.1	.2	1.0	1.0	.7	.3	.2	.2	.6	3.4	7.7	17.0	23.0	32.5	12.0
Texas	3,936	--------	--------	--------	--------	--------	1.7	--------	.3	--------	.6	13.3	10.6	14.1	13.8	16.7	28.9
Utah	4,116	--------	.1	--------	.3	--------	2.4	--------	--------	.5	--------	6.4	9.6	27.2	30.6	7.2	15.7
Virginia	11,004	--------	.3	--------	.5	--------	.1	1.2	1.0	.3	.2	1.6	5.6	19.9	8.3	13.6	47.4
Washington	5,109	--------	--------	--------	--------	.1	.1	2.1	1.5	--------	2.8	1.8	3.5	3.1	19.0	53.4	12.6
West Virginia	89,357	--------	.1	.1	.2	.4	.8	1.2	2.3	3.6	7.7	13.7	17.7	21.3	13.8	13.4	3.7
Wyoming	7,552	--------	--------	--------	--------	.2	--------	1.6	3.1	4.7	4.3	2.8	8.5	2.3	8.0	33.7	30.8
	613,775	.1	.2	.3	.4	.5	.9	1.1	1.9	2.8	4.6	8.9	12.8	17.5	17.3	20.6	10.1
1921																	
Alabama	25,814	1.6	5.9	1.2	3.0	3.3	6.5	12.6	16.3	8.3	7.2	13.4	8.7	.6	4.2	--------	7.2
Arkansas	3,618	9.7	5.8	7.0	.4	6.8	15.7	20.7	17.2	.9	9.6	5.2	.5	.5	--------	--------	--------
California	62	--------	100.0	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Colorado	14,531	--------	3.3	3.6	2.2	2.7	10.7	8.0	9.6	16.0	18.6	12.4	5.6	5.9	.3	.1	1.0
Georgia	136	--------	--------	--------	--------	--------	--------	--------	--------	--------	100.0	--------	--------	--------	--------	--------	--------
Idaho	7	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	100.0	--------	--------	--------
Illinois	95,431	2.5	2.5	1.9	4.4	6.4	8.1	13.1	13.6	16.1	13.7	5.4	5.3	4.3	1.9	.3	.5
Indiana	32,689	6.4	3.5	4.4	9.8	11.8	12.1	8.0	14.0	9.4	3.9	7.9	2.9	5.0	.6	.3	--------
Iowa	11,386	.6	1.1	4.6	8.9	5.6	8.9	13.2	18.0	5.4	12.8	11.5	4.0	1.0	3.9	--------	.5
Kansas	8,207	.6	1.7	2.9	3.4	2.5	18.1	20.9	26.6	12.5	4.9	4.6	--------	.9	--------	.1	.3
Kentucky	50,528	2.6	4.0	2.6	4.6	11.2	10.2	8.9	12.2	10.8	4.6	8.6	6.0	4.3	2.7	6.5	.2
Maryland	4,669	11.6	9.1	16.6	7.4	4.9	5.4	2.4	7.1	1.8	2.1	10.1	13.7	7.7	.1	--------	--------
Michigan	2,212	--------	--------	--------	--------	--------	10.4	23.9	6.6	4.6	--------	--------	11.8	35.4	7.3	--------	--------
Missouri	8,555	--------	.7	5.0	10.5	8.2	5.6	7.6	6.4	14.4	8.3	9.5	9.1	8.7	1.9	.3	3.8
Montana	4,178	13.7	5.0	1.1	.5	3.2	13.0	11.2	4.5	11.5	3.8	1.8	29.3	1.1	--------	--------	.3
New Mexico	4,577	--------	--------	--------	.3	3.0	9.4	20.3	46.5	16.6	--------	.2	.3	.6	--------	--------	2.8
North Carolina	60	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
North Dakota	1,064	--------	.2	1.9	.9	2.3	3.4	3.0	.9	32.7	13.5	9.4	13.7	2.8	4.9	.4	10.0
Ohio	51,790	5.7	5.5	7.6	4.7	4.7	11.5	11.1	12.1	11.8	6.9	6.2	4.5	2.6	3.0	1.9	.2
Oklahoma	8,855	10.1	1.5	4.7	6.6	9.1	6.8	9.7	10.3	9.3	12.2	4.8	3.3	1.9	6.2	--------	3.5
Oregon	72	--------	--------	4.2	--------	--------	--------	--------	--------	--------	--------	--------	--------	95.8	--------	--------	--------
Pennsylvania	190,698	1.9	4.9	5.2	6.5	8.6	6.7	13.7	8.9	8.0	9.1	7.7	4.6	4.8	3.1	4.5	1.8
South Dakota	43	7.0	4.7	18.6	--------	11.6	2.3	4.7	4.7	--------	--------	46.4	--------	--------	--------	--------	--------
Tennessee	10,345	1.1	3.0	6.1	4.0	8.4	9.6	6.9	7.2	12.7	19.7	4.7	7.4	5.0	2.7	1.5	--------
Texas	2,893	--------	24.7	1.5	2.6	4.1	8.8	8.4	.7	24.2	--------	10.2	1.8	3.2	5.2	4.6	--------
Utah	4,423	--------	1.2	--------	4.0	23.5	4.7	7.8	16.1	7.6	18.9	3.3	.9	3.2	8.8	--------	--------
Virginia	11,922	2.2	3.6	.7	2.4	.6	3.2	14.0	11.9	9.7	14.9	29.0	2.6	3.8	1.4	--------	--------
Washington	4,334	3.9	1.9	5.7	1.3	8.4	5.1	13.1	12.4	--------	.8	33.8	6.2	6.1	1.0	--------	.3
West Virginia	101,870	3.4	4.5	4.7	5.0	7.6	8.2	13.5	9.9	8.0	9.6	9.7	4.7	5.0	2.1	2.8	1.3
Wyoming	8,484	.7	.7	--------	15.1	.8	1.6	7.6	6.2	17.8	27.6	6.2	7.6	3.4	2.6	2.1	--------
	663,453	2.9	4.1	4.2	5.4	7.4	8.3	12.4	11.4	10.3	9.6	8.3	5.1	4.3	2.5	2.5	1.3

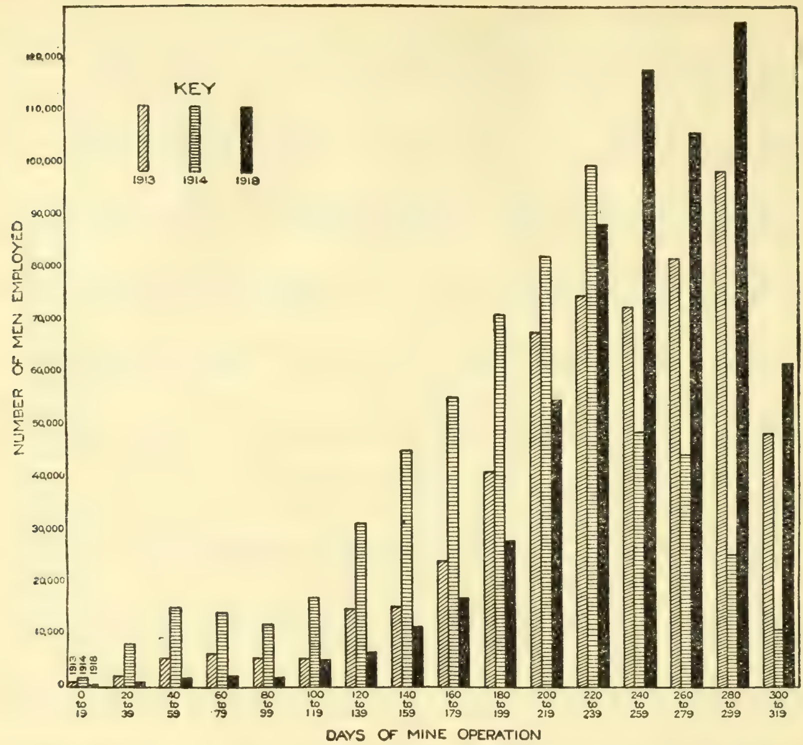

FIGURE 36.—Number of men employed in bituminous coal mines that worked specified number of days in 1913, a normal year; 1914, a year of depression; and 1918, the year of maximum activity

TABLE 27.—*Average number of days worked by coal mines, 1913–1923*

State	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Alabama	255	226	223	262	273	278	239	247	166	215	232
Alaska	(a)	(a)	(a)	179	(a)	254	280	240	244	147	220
Arkansas	174	143	149	184	187	204	136	176	112	81	97
California [a]	302	291	285	188	173	240	59	181	149	250	206
Colorado	229	244	194	233	263	255	225	255	164	191	174
Georgia	261	207	197	280	269	258	284	294	183	242	231
Idaho	[b] 183	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Illinois	189	173	179	198	243	238	160	213	152	120	158
Indiana	190	168	179	187	221	227	148	192	128	110	136
Iowa	195	204	220	202	251	245	176	250	148	131	181
Kansas	197	192	184	204	216	234	182	204	137	125	139
Kentucky	212	187	186	208	214	230	189	182	152	140	152
Maryland	248	241	242	256	254	261	179	207	120	101	178
Michigan	188	201	198	216	254	237	179	261	196	162	222
Missouri	187	179	186	207	240	235	175	233	166	113	155
Montana	228	209	201	244	268	264	194	250	143	140	179
New Mexico	289	283	262	292	321	301	273	302	150	216	216
North Carolina	----	----	----	----	----	40	100	288	300	167	275
North Dakota	221	216	219	244	255	229	216	218	194	175	182
Ohio	206	108	142	197	210	223	164	188	134	100	150
Oklahoma	197	205	167	178	211	228	184	217	141	114	133
Oregon	283	266	206	236	251	292	259	307	(a)	(a)	(a)
Pennsylvania (bit.)	267	214	226	259	261	269	218	244	151	154	213
South Dakota	137	152	155	145	154	145	164	133	129	138	122
Tennessee	241	220	220	239	241	265	201	234	154	163	183
Texas	253	237	233	218	263	262	227	242	139	185	178
Utah	273	210	208	228	219	258	239	252	151	204	160
Virginia	280	235	235	272	273	277	247	262	166	198	212
Washington	260	191	169	217	271	275	217	260	159	194	213
West Virginia	234	201	208	237	225	238	200	198	149	143	169
Wyoming	232	192	201	248	246	268	221	264	167	128	192
Total bituminous	232	195	203	230	243	249	195	220	149	142	179
Pennsylvania anthracite	257	245	230	253	285	293	266	271	271	151	268
Grand total	238	207	209	235	251	258	209	230	173	144	195

[a] California includes Alaska in 1913; Idaho and Nevada, 1914 and 1915 (number of days not reported for Alaska); Idaho, 1916–1920 (number of days not reported for Alaska in 1917); and Idaho and Oregon, 1921–1923.

[b] Includes Nevada.

THE EARLIEST RECORD OF TIME WORKED AND LOST AT SOFT-COAL MINES

For purposes of comparison, the following table, abstracted from the census of 1880, is of interest. It gives the first statistical record known to the writers of time worked and lost at the bituminous-coal mines. In Table 29 a comparison of the working year in 1880, 1920, and 1923 is given. It shows that the problem of idle time at the mines existed in 1880 but in less acute form than to-day.

TABLE 28.—*Average percentage of year worked, idle, and lost in strikes at bituminous-coal mines in year ending June 1, 1880*

[From data in Tenth Census, vol. 15, Mining industries, p. 683]

State	Worked	Idle except from strikes	Lost in strikes
Alabama	91.54	2.78	5.68
Georgia	100.00	.00	.00
Illinois	78.15	17.32	4.53
Indiana	74.34	21.36	4.30
Iowa	69,52	24.14	6.34
Kentucky	62.00	23.60	4.40
Maryland	69.93	17.60	12.47
Ohio	77.90	13.55	8.55
Pennsylvania	75.73	17.28	6.99
Tennessee	91.15	8.79	.06
Virginia	61.06	38.94	.00
West Virginia	69.05	23.57	7.38
United States	75.70	17.62	6.68

TABLE 29.—*Days worked and lost at bituminous-coal mines, 1880, 1920, and 1923*

	1880 [a]	1920	1923
Days worked	233	220	179
Days lost on account of strikes	21	6	2
Days lost for other causes	54	82	127
Total days lost	75	88	129
Total days	308	308	308

[a] Figures as first published expressed in per cent of the working year.

HOURS OF LABOR

The only change of consequence in the customary hours of labor in the mines that occurred in 1923 was the application of the eight-hour day to those few occupations in the anthracite region that had not been affected by the agreement of 1916. In the agreement of September, 1923, the anthracite operators accepted the suggestion of Governor Pinchot, of Pennsylvania, that the few remaining employees be placed upon the 8-hour basis. A study made by the United States Coal Commission of the hours worked by 44,003 employees in the anthracite region in April, 1923, showed only 907, or 2.06 per cent, then working in excess of 8 hours.

In the bituminous-coal fields little change in the length of the working day occurred in 1923. The 8-hour day, long the standard in union districts, has now been accepted so generally by the nonunion fields that a weighted average of the working day for the industry as a whole would be 8.06 hours. About 4.2 per cent of the men are still employed in mines that run 9 hours, and only 1.1 per cent are in 10-hour mines. The longer day is confined to Alabama and parts of eastern Kentucky, southern West Virginia, and the nonunion districts of Pennsylvania.

Even here, however, it stands out as the exception rather than the rule.

In Alabama alone are a majority of the men employed in mines that work longer than 8 hours. Of 288 mines in that State reporting in 1923, 143 gave the 8-hour day as their standard. These 143 mines employed 12,989 men, or 43 per cent of the total number in the State. There were 74 mines employing 12,478 men that reported 9 hours as the standard working day, and 21 other mines employing 3,061 men that reported 10 hours. (See Table 30.) This condition is a change from that reported by Alabama operators in 1921, when 87 per cent of the men were employed in 8-hour mines. These figures show not the average number of hours worked by each employee, but the length of time that the mine as a whole is open for work. The tonnage men are less regular in their hours than the day men. Some employees leave before the end of the established day. Other men, particularly in the nonunion fields, may enter the mine for work before the established hour or remain after their fellows have gone. There are also occupations which require the men's presence for more than 8 hours. In some districts the tipple crews are regularly expected to work 9 or 10 hours, though the mine time is limited to 8.

The gratifying progress in the adoption of the 8-hour day is recorded in Table 31, which shows the trend from 1903 to 1923. In 1903 the weighted average working day was 8.7 hours. In 1904 it fell to 8.6 hours, and there it stood until 1917, when changes in the labor market brought about by the war resulted in the rapid extension of the shorter day through the nonunion fields. Between 1916 and 1919 the proportion of the employees engaged in 8-hour mines increased from 58.6 to 95.5 per cent of the total and the average working day dropped from 8.6 to 8.06 hours. This was the most notable change since 1898, when the 8-hour day was written into the first wage agreement in the Central Competitive Field.

These changes in the length of the working day must be taken into account in considering the output per man per day. The large increase in output per worker is the more gratifying because it has been accompanied by a decline in the length of the working day. The reduction in the length of day arrested for a time the upward tendency in output per man that had begun many years before, and for the single year 1917 the trend was downward. But the forces tending to increase output soon overcame the effect of the shorter day and may be summarized in the statement that whereas in 1911 an average working day of 8.6 hours produced 4.01 tons per man underground, a day of 8.06 hours in 1923 produced an average of 5.15 tons per man underground. To what extent, if at all, reduction in the working time was itself a cause of the increased output the record does not disclose. (See fig. 37.)

TABLE 30.—*Number of bituminous-coal mines having established working days of certain length and number of men employed, 1922–23*

[Wagon mines not included]

State	8 hours		9 hours		10 hours		All others and not reporting[a]		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
1922										
Alabama	140	13,192	70	10,646	23	2,724	47	1,607	280	28,169
Alaska	11	412					2	18	13	430
Arkansas	97	3,930	1	40	1	55	3	10	102	4,035
California, Idaho, and Oregon	3	60							3	60
Colorado	180	[b]13,187					55	319	235	13,506
Georgia	1	150							1	150
Illinois	477	95,338	3	22			131	976	611	96,336
Indiana	253	32,645	1	5			42	558	296	33,208
Iowa	132	12,744					27	113	159	12,857
Kansas	122	7,308					11	51	133	7,359
Kentucky	760	54,782	59	4,755	24	653	57	734	900	60,924
Maryland	76	3,671			1	28	8	56	85	3,755
Michigan	12	2,142					1	24	13	2,166
Missouri	138	8,478	4	64			20	208	162	8,750
Montana	35	3,572					18	63	53	3,635
New Mexico	34	[b]3,969	1	16			5	16	40	4,001
North Carolina	2	127							2	127
North Dakota	44	1,071			4	152	54	425	102	1,648
Ohio	796	52,777	11	179	10	717	128	521	945	54,194
Oklahoma	118	7,597	3	116	3	96	4	19	128	7,828
Pennsylvania	2,551	[b]182,403	83	4,218	15	580	226	1,637	2,875	188,838
South Dakota							15	32	15	32
Tennessee	172	10,919	2	530					174	11,449
Texas	15	1,267	12	833	4	465	8	276	39	2,841
Utah	37	4,710	1	10			2	1	40	4,721
Virginia	153	[b]13,028	6	253	3	67	6	51	168	13,399
Washington	47	4,481							47	4,481
West Virginia	1,528	104,047	[c]46	[c]5,147	12	619	30	201	1,616	110,014
Wyoming	61	9,043					1	2	62	9,045
	7,995	647,050	303	26,834	100	6,156	901	7,918	9,299	687,958
1923										
Alabama	143	12,989	74	12,478	21	3,061	50	1,507	288	30,035
Alaska	8	181					4	18	12	199
Arkansas	87	3,551	1	40	3	153	3	10	94	3,754
California, Idaho, and Oregon	5	93							5	93
Colorado	169	[b]12,934	2	175			65	231	236	13,340
Georgia	1	147					2	20	3	167
Illinois	455	98,809			1	16	119	889	575	99,714
Indiana	264	35,116	1	2			36	290	301	35,408
Iowa	131	11,353					20	95	151	11,448
Kansas	209	9,697	1	5			12	59	222	9,761
Kentucky	666	53,428	65	5,239	18	855	86	1,289	835	60,811
Maryland	94	3,646			1	26	10	53	105	3,725
Michigan	12	1,939					1	38	13	1,977
Missouri	129	6,744	2	61			18	147	149	6,952
Montana	32	3,445					16	66	48	3,511
New Mexico	35	[b]4,072					7	23	42	4,095
North Carolina	2	150							2	150
North Dakota	52	1,218	3	40	3	92	64	271	122	1,621
Ohio	773	[b]53,555	6	120	8	372	119	508	906	54,555
Oklahoma	107	6,873	4	183	2	70	2	4	115	7,130
Pennsylvania	2,463	187,681	95	4,881	11	368	299	2,051	2,868	194,981
South Dakota							15	34	15	34
Tennessee	175	10,624			5	[d]548	11	72	191	11,244
Texas	15	885	17	695	5	454	7	418	44	2,452
Utah	35	4,375					2	6	37	4,381
Virginia	140	[b]12,883	5	229	5	869	18	139	168	14,120
Washington	54	4,298					2	8	56	4,306
West Virginia	1,542	[b]110,599	48	4,972	17	1,146	59	583	1,666	117,300
Wyoming	61	7,524					1	5	62	7,529
	7,859	658,809	324	29,120	100	8,030	1,048	8,834	9,331	704,793

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[a] Includes employees in mines where the established working day was changed during the year or where the working day was irregular or in mines which failed to answer the inquiry.

[b] Includes outside employees working 9 or 10 hours a day at certain mines where the established time for underground workers is 8 hours.

[c] Includes 816 men working 8 hours prior to September.

[d] Worked 9 hours first of year and 10 hours last of year.

TABLE 31.—*Percentage of men employed in bituminous-coal mines that had established working day of 8, 9, and 10 hours, 1903–1923* [a]

Year	Per cent of total employees in—			Weighted average working day (hours)	Year	Per cent of total employees in—			Weighted average working day (hours)
	8-hour mines	9-hour mines	10-hour mines			8-hour mines	9-hour mines	10-hour mines	
1903	56. 4	17. 1	26. 5	8. 7	1914	60. 7	15. 4	23. 9	8. 6
1904	62. 1	13. 8	24. 1	8. 6	1915	59. 6	17. 0	23. 4	8. 6
1905	61. 1	13. 6	25. 3	8. 6	1916	58. 6	17. 4	24. 0	8. 6
1906	63. 0	13. 5	23. 5	8. 6	1917	79. 0	12. 6	8. 4	8. 3
1907	64. 0	11. 6	24. 4	8. 6	1918	90. 6	6. 7	2. 7	8. 12
1908	63. 5	11. 1	25. 4	8. 6	1919	95. 5	3. 5	1. 0	8. 06
1910	62. 1	11. 3	26. 6	8. 6	1920	97. 1	2. 0	. 9	8. 04
1911	62. 9	10. 9	26. 2	8. 6	1921	96. 6	2. 9	. 5	8. 04
1912	61. 6	11. 5	26. 9	8. 6	1922	95. 1	4. 0	. 9	8. 06
1913	61. 9	15. 2	22. 9	8. 6	1923	94. 7	4. 2	1. 1	8. 06

[a] Percentages are calculated on base of total number of men in mines definitely reported as having 8-hour, 9-hour, or 10-hour day. A small number of mines that work more than 10 hours or less than 8 hours have been excluded, as have also all mines for which the reports were defective or which changed their working day during the year. Data not available for 1909.

PRODUCTION PER MAN PER DAY

METHOD OF COMPUTATION AND VALUE OF THE AVERAGE

If the total output in a year is divided by the number of men employed the quotient will show the production per man for each year. If this figure in turn is divided by the average number of days the mines worked the final quotient will show the average production per man per day. For the bituminous-coal mines in 1923 the average production per man for the year was 801 tons, and the average per man per day was 4.47 tons. The average production per man per day is thus determined by arithmetical calculation rather than by engineering observation. The man who actually digs the coal gets out more

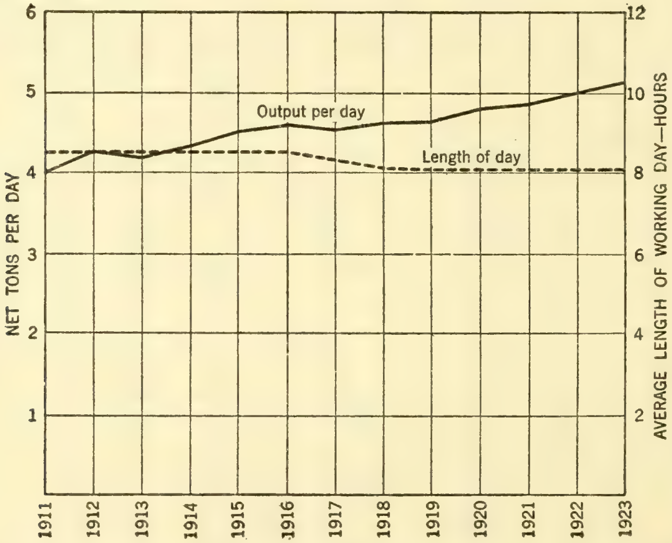

FIGURE 37.—Output of bituminous coal per man underground per day and average length of established working day, 1911–1923

per eight-hour day than 4.47 tons. The average daily product of his work is pulled down by the inclusion of the day men above and below ground, by the fact that tonnage men do not work every day that the mine is worked, by the fact that they frequently go home before the mine as a whole stops, and by the fact that men underground can not work continuously, because of unavoidable delays, such as that caused by waiting for mine cars. Nevertheless the average thus determined, which can be so easily calculated from the records available, is of value because it affords at least a rough indication of the units of labor necessary to raise a ton of coal and prepare it for shipment under the conditions that prevail at any time and place.

AVERAGE DAILY OUTPUT FOR ALL MEN EMPLOYED

Tables 33 to 35 present the statistics of production per day for all men employed. The variations in productivity from State to State are the subject of Table 32. The trend of production per man since 1890, when the historical record begins, is shown in Table 33 for the anthracite and bituminous-coal industries as a whole. The trend in certain of the important bituminous-coal States from 1900 to 1923 is given in Table 34 and Figure 38. Chief among the factors controlling output per worker are the natural conditions of mining—notably thickness of the seam—and the use of machinery. Statistical data on these points will be found in the report of the United States Coal Commission, pages 1877–1892.

TABLE 32.—*Coal produced per man and average number of days worked per year, 1921–1923, by States*

State	1921			1922			1923		
	Days mine worked	Average tonnage per man		Days mine worked	Average tonnage per man		Days mine worked	Average tonnage per man	
		Per year	Per day		Per year	Per day		Per year	Per day
Alabama	166	487	2.93	215	647	3.01	232	680	2.93
Arkansas	112	340	3.03	81	269	3.32	97	329	3.39
Colorado	164	628	3.83	191	740	3.87	174	774	[a] 4.45
Illinois	152	729	4.80	120	606	5.05	158	795	5.02
Indiana	128	622	4.86	110	571	5.19	136	738	5.43
Iowa	148	398	2.69	131	334	2.55	181	498	2.75
Kansas	137	422	3.08	125	377	3.02	139	443	3.19
Kentucky	152	625	4.11	140	684	4.89	152	735	4.83
Maryland	120	392	3.27	101	318	3.15	178	608	3.42
Michigan	196	516	2.63	162	429	2.65	222	593	2.67
Missouri	166	415	2.50	113	326	2.88	155	477	3.07
Montana	143	654	4.57	140	704	5.03	179	896	5.00
New Mexico	150	536	3.58	216	779	3.61	216	708	3.28
North Dakota	194	813	4.19	175	769	4.39	182	837	4.60
Ohio	134	617	4.60	100	492	4.92	150	742	4.95
Oklahoma	141	380	2.70	114	356	3.12	133	398	2.99
Pennsylvania:									
Anthracite	271	567	2.09	151	349	2.31	268	592	2.21
Bituminous	151	609	4.03	154	592	3.84	213	882	4.15
Tennessee	154	431	2.80	163	422	2.59	183	536	2.93
Texas	139	336	2.42	185	389	2.10	178	484	2.72
Utah	151	922	[a] 6.10	204	1,057	[a] 5.18	160	1,077	[a] 6.73
Virginia	166	628	3.78	198	779	3.93	212	832	3.92
Washington	159	560	3.52	194	575	2.96	213	680	3.19
West Virginia	149	715	4.79	143	729	5.10	169	919	5.44
Wyoming	167	849	5.08	128	659	5.15	192	1,004	5.23

[a] The figures for Utah and for Colorado in 1923 are probably too high because of the practice of men going into the mine to shoot coal and load mine cars on days when the tipple and the mine as a whole were not in operation. See note [b], p. 658.

TABLE 33.—*Coal produced per man employed, 1890–1923*

Year	Anthracite				Bituminous			
	Men employed	Days worked	Average tonnage		Men employed	Days worked	Average tonnage	
			Per day	Per year			Per day	Per year
1890	126,000	200	1.85	369	192,204	226	2.56	579
1891	126,350	203	1.98	401	205,803	223	2.57	573
1892	129,050	198	2.06	407	212,893	219	2.72	596
1893	132,944	197	2.06	406	230,365	204	2.73	557
1894	131,603	190	2.08	395	244,603	171	2.84	486
1895	142,917	196	2.07	406	239,962	194	2.90	563
1896	148,991	174	2.10	365	244,171	192	2.94	564
1897	149,884	150	2.34	351	247,817	196	3.04	596
1898	145,504	152	2.41	367	255,717	211	3.09	651
1899	139,608	173	2.50	433	271,027	234	3.05	713
1900	144,206	166	2.40	398	304,375	234	2.98	697
1901	145,309	196	2.37	464	340,235	225	2.94	664
1902	148,141	116	2.40	279	370,056	230	3.06	703
1903	150,483	206	2.41	496	415,777	225	3.02	680
1904	155,861	200	2.35	469	437,832	202	3.15	637
1905	165,406	215	2.18	470	460,629	211	3.24	684
1906	162,355	195	2.25	439	478,425	213	3.36	717
1907	167,234	220	2.33	512	513,258	234	3.29	769
1908	174,174	200	2.39	478	516,264	193	3.34	644
1909 [a]	[b] 173,504	[c] 205	([d])	([d])	[b] 543,152	[c] 209	([d])	([d])
1910	169,497	229	2.17	498	555,533	217	3.46	751
1911	172,585	246	2.13	524	549,775	211	3.50	738
1912	174,030	231	2.10	485	548,632	223	3.68	820
1913	175,745	257	2.02	520	571,882	232	3.61	837
1914	179,679	245	2.06	505	583,506	195	3.71	724
1915	176,552	230	2.19	504	557,456	203	3,91	794
1916	159,869	253	2.16	548	561,102	230	3.90	896
1917	154,174	285	[e] 2.27	[e] 646	603,143	243	3.77	915
1918	147,121	293	[e] 2.29	[e] 672	615,305	249	3.78	942
1919	154,571	266	2.14	570	621,998	195	3.84	749
1920	145,074	271	[e] 2.28	[e] 618	639,547	220	4.00	881
1921	159,499	271	2.09	567	663,754	149	4.20	627
1922	156,849	151	2.31	349	687,958	142	4.28	609
1923	157,743	268	2.21	592	704,793	179	4.47	801

[a] No reports of number of employees and days worked were collected by the Geological Survey in 1909.

[b] Number of wage earners on December 15 as reported by census of mines and quarries for 1909. The figures for bituminous coal exclude coke workers.

[c] Estimated.

[d] Comparable data not available.

[e] Heavy washery output.

TABLE 34.—*Bituminous coal produced per man per day, 1900–1908, 1910–1923, in net tons*

[Computed by dividing the total production of commercial mines in tons by the product of the average number of days worked by the mines and the average number of men employed. No data available for 1909]

Year	Total United States	Ohio	Indiana	Illinois	Pennsylvania	Colorado	West Virginia	Kentucky
1900	2.98	3.20	2.78	2.92	3.56	2.66	3.36	2.43
1901	2.94	3.29	2.75	2.97	3.53	2.54	3.55	2.49
1902	3.06	3.02	2.98	3.08	3.52	3.16	3.38	2.35
1903	3.02	3.05	3.22	3.21	3.40	3.28	3.36	2.54
1904	3.15	3.20	3.14	3.13	3.70	3.14	3.49	2.71
1905	3.24	3.35	3.11	3.29	3.57	3.14	3.74	2.87
1906	3.36	3.65	3.30	3.49	3.68	3.32	3.86	2.98
1907	3.29	3.45	3.38	3.59	3.61	2.94	3.54	3.02
1908	3.34	3.44	3.85	3.79	3.51	3.13	3.98	3.24
1910	3.46	3.61	3.67	3.95	3.61	3.20	3.94	3.26
1911	3.50	3.73	3.68	3.73	3.69	3.42	4.05	3.18
1912	3.68	3.77	3.88	3.95	3.89	3.72	4.31	3.38
1913	3.61	3.83	4.06	4.10	3.78	3.36	4.07	3.51
1914	3.71	3.84	4.27	4.18	3.75	3.32	4.52	3.79
1915	3.91	3.94	4.17	4.35	4.00	3.60	4.89	4.11
1916	3.90	4.26	4.48	4.42	3.91	3.43	[a] 4.68	[a] 3.91
1917	[a] 3.77	4.26	4.52	4.22	3.80	3.33	[a] 4.35	[a] 3.72
1918	[a] 3.78	4.24	4.45	4.37	3.81	3.36	[a] 4.22	[a] 3.50
1919	[a] 3.84	4.41	4.72	4.48	3.96	3.88	[a] 4.18	[a] 3.49
1920	4.00	4.73	4.36	4.78	3.96	3.51	4.39	3.95
1921	4.20	4.60	4.86	4.80	4.03	3.83	4.79	4.11
1922	4.28	4.92	5.19	5.05	[b] 3.84	3.87	5.10	4.89
1923	4.47	4.95	5.43	5.02	4.15	4.45	5.44	4.83

[a] Apparent decrease largely explained by adoption of the 8-hour day in certain nonunion fields.

[b] Affected by strike.

AVERAGE FOR DEEP MINES PER MAN EMPLOYED UNDERGROUND

In Mineral Resources for 1922, Part II, page 505, were pointed out a number of factors that impair the comparability of the figures of average daily output for all men employed. A better index of changes in output per man is the average production of coal from deep mines per man employed underground. This figure, which is given in the following table, eliminates the errors due to the inclusion of coal from strip pits, dredges, and washeries and to the variations in the number of workers employed in preparing the coal at the tipple or breaker. Unfortunately the records do not permit a calculation of this average for the years prior to 1911.

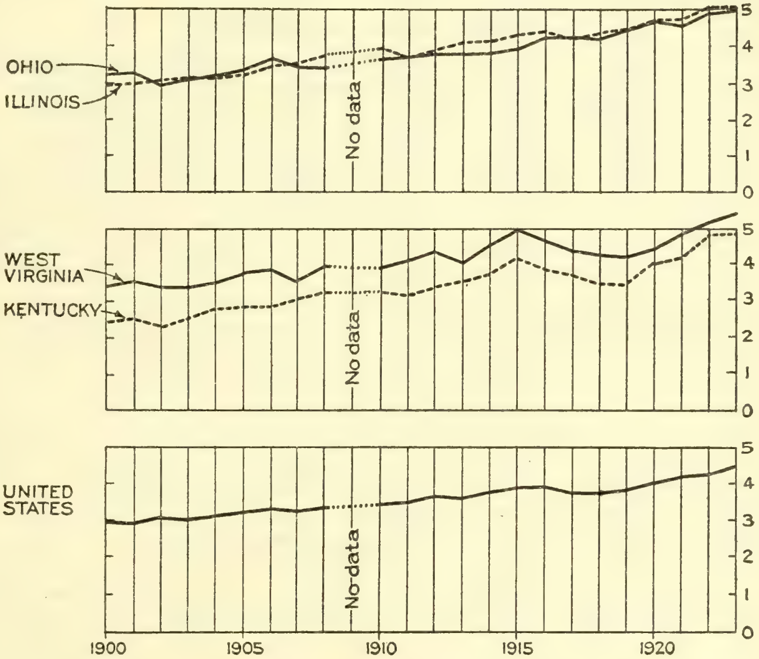

FIGURE 38.—Output of bituminous coal per man employed per day in two union and two nonunion States and in the United States as a whole, 1900–1923. The apparent decrease in 1916–1919 is due to the adoption of the 8-hour day in certain nonunion fields

It will be noted that this average of deep-mined coal per man employed underground fluctuates less than the simple average of all coal per man employed. The average for bituminous coal shows a fairly steady increase from 1911 to 1923, amounting in all to 1.14 tons, or 28 per cent. (See fig. 37.) In the meantime the length of the established working day had declined from 8.6 hours in 1911 to 8.06 hours in 1923. The average for anthracite, on the other hand, shows but little change during the period, for the average in 1923 was 2.79 net tons, against 2.75 tons in 1911. This figure, like that for bituminous coal, makes no allowance for changes in the length of the working day.

TABLE 35.—*Coal produced from deep mines per man employed underground per day worked, 1911–1923, in net tons* [a]

Year	Anthracite	Bituminous	Year	Anthracite	Bituminous
1911	2.75	4.01	1918	2.94	4.62
1912	2.69	4.24	1919	2.81	4.64
1913	2.67	4.16	1920	2.93	4.80
1914	2.67	4.28	1921	2.70	4.86
1915	2.78	4.49	1922	2.87	4.98
1916	2.74	4.57	1923	2.79	5.15
1917	2.89	4.51			

[a] In making this computation certain estimates had to be made of the division of workers above and below ground and of the production of strip pits in the years 1911 to 1913. The probable error introduced by these estimates is too small to impair the value of the averages.

STRIKES AND LOCKOUTS

The statistics of strikes and lockouts published by the Geological Survey were discussed in detail in connection with the figures for the great strike of 1922 [13] and are the subject of a special study now in preparation. It will therefore be sufficient here to present the figures for 1923 without extended comment (Tables 36, 37, and 38).

In the anthracite region the year 1923 was marked by a brief suspension in September between the expiration of the wage agreement of 1922, on August 31, and the ratification of the new agreement proposed by Governor Pinchot. This suspension with certain local strikes caused a loss of 2,629,418 potential man-days, an average of 17 days per man employed. In the bituminous fields the year was generally free from strikes (Table 38). In the Cumberland-Piedmont fields of Maryland and West Virginia, however, the contest begun in 1922 dragged on for many months in 1923. Starting on April 1, 1922, it was not declared off until November 22, 1923, and therefore lasted nearly 20 months. The average time lost per man striking in Maryland was 134 days and the average per man employed, 97 days.

Table 38 also records a stoppage involving 137 men in Texas which lasted 132 days. Two companies were involved. In the case of the larger company the controversy arose over the renewal of the wage contract which expired March 31, 1923. The company declaring itself unable to pay the old scale because of the competition of fuel oil, and the union being unwilling to consider a reduction, a deadlock ensued which was ended by the company's reopening one of its two mines on a nonunion basis.

TABLE 36.—*Summary of strikes and lockouts in coal mines, 1899–1923*

Year	Number of men on strike	Total man-days idle	Average number of days lost per man striking	Year	Number of men on strike	Total man-days idle	Average number of days lost per man striking
1899	45,981	2,124,154	46	1912	311,056	12,527,305	40
1900	131,973	4,878,102	37	1913	135,395	3,049,412	22.5
1901 [a]	20,593	733,802	35	1914	161,720	11,013,667	68
1902	200,452	16,672,217	83	1915	67,190	2,467,431	37
1903 [a]	47,481	1,341,031	28	1916	170,633	3,344,586	20
1904	77,661	3,382,830	44	1917	160,240	2,348,399	15
1905	37,542	796,735	21	1918	79,395	508,526	6
1906	372,343	19,201,348	51.5	1919	453,418	15,761,410	35
1907 [a]	32,540	462,392	14	1920	282,419	5,914,473	21
1908 [a]	145,145	5,449,938	38	1921	151,263	3,106,103	21
1909	25,534	731,650	29	1922	603,031	73,497,043	122
1910	218,493	19,250,524	88	1923	197,214	3,868,543	20
1911	41,413	983,737	24				

[a] Bituminous coal mines only. No strikes of consequence occurred in the anthracite region in these years.

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[13] U. S. Geol. Survey Mineral Resources, 1922, pt. 2, pp. 512–519, 1924.

TABLE 37.—*Days lost at coal mines on account of strikes and lockouts compared with days lost for other causes, 1900–1923*

[Includes both anthracite and bituminous coal mines]

Year	Days lost			Year	Days lost		
	On account of strikes and lockouts	On account of no market, car shortage, and similar difficulties	Total		On account of strikes and lockouts	On account of no market, car shortage, and similar difficulties	Total
1900	4, 878, 102	38, 122, 900	43, 001, 002	1913	3, 049, 412	49, 376, 615	52, 426, 027
1901 [a]	733, 802	43, 780, 311	44, 514, 113	1914	11, 013, 667	66, 242, 288	77, 255, 955
1902	16, 672, 217	40, 635, 223	57, 307, 440	1915	2, 467, 431	69, 836, 505	72, 303, 936
1903 [a]	1, 341, 031	48, 517, 726	49, 858, 757	1916	3, 344, 586	49, 214, 165	52, 558, 751
1904	3, 382, 830	59, 860, 350	63, 243, 180	1917	2, 348, 399	40, 401, 898	42, 750, 297
1905	796, 735	59, 267, 036	60, 063, 771	1918	508, 526	38, 001, 284	38, 509, 810
1906	19, 201, 348	44, 595, 142	63, 796, 490	1919	15, 761, 410	61, 023, 906	76, 785, 316
1907 [a]	462, 392	52, 235, 292	52, 697, 684	1920	5, 914, 473	55, 732, 698	61, 647, 171
1908 [a]	5, 449, 938	72, 731, 214	78, 181, 152	1921	3, 106, 103	108, 332, 246	111, 438, 349
1909	731, 650	64, 332, 335	65, 063, 985	1922	73, 497, 043	65, 186, 691	138, 683, 734
1910	19, 250, 524	44, 693, 242	63, 943, 766	1923	3, 868, 543	93, 359, 474	97, 228, 017
1911	983, 737	63, 044, 708	64, 028, 445				
1912	12, 527, 305	47, 506, 725	60, 034, 030		211, 291, 204	1, 376, 029, 974	1, 587, 321, 178

[a] No serious strikes occurred in the anthracite region in these years.

TABLE 38.—*Strikes and lockouts in coal mines, 1922–23*

State	1922					1923				
	Total number of men employed	Number of men on strike	Man-days idle on account of strike	Average number of days lost on account of strike		Total number of men employed	Number of men on strike	Man-days idle on account of strike	Average number of days lost on account of strike	
				Per man employed	Per man on strike				Per man employed	Per man on strike
Alabama	28, 169	46	167	([a])	4	30, 035	------	------	------	------
Arkansas	4, 035	3, 691	435, 507	108	118	3, 754	324	9, 009	2	28
Colorado	13, 506	6, 672	527, 250	39	79	13, 340	------	------	------	------
Illinois	96, 336	93, 584	11, 547, 829	120	123	99, 714	7, 474	95, 458	1	13
Indiana	33, 208	31, 721	3, 924, 396	118	124	35, 408	10, 765	104, 604	3	10
Iowa	12, 857	12, 192	1, 479, 497	115	121	11, 448	1, 946	19, 874	2	10
Kansas	7, 359	6, 515	847, 075	115	130	9, 761	949	24, 741	3	26
Kentucky	60, 924	10, 270	605, 441	10	59	60, 811	2, 699	92, 035	2	34
Maryland	3, 755	4, 446	688, 206	183	155	3, 725	2, 686	359, 920	97	134
Michigan	2, 166	2, 062	247, 919	114	120	1, 977	786	3, 992	2	5
Missouri	8, 750	7, 535	939, 192	107	125	6, 952	312	10, 857	2	35
Montana	3, 635	3, 361	428, 678	118	128	3, 511	25	25	([a])	([a])
New Mexico	4, 001	585	75, 135	19	128	4, 095	------	------	------	------
North Dakota	1, 648	578	49, 238	30	85	1, 621	85	6, 933	4	82
Ohio	54, 194	46, 283	5, 502, 885	102	118	54, 555	16, 486	203, 161	4	12
Oklahoma	7, 828	5, 872	773, 127	99	132	7, 130	1, 020	8, 211	1	8
Pennsylvania (bituminous)	188, 838	155, 604	18, 388, 895	97	118	194, 981	10, 984	157, 130	1	14
Tennessee	11, 449	5, 864	482, 231	42	82	11, 244	572	24, 766	2	43
Texas	2, 841	693	13, 867	5	20	2, 452	137	18, 141	7	132
Utah	4, 721	2, 111	212, 896	45	101	4, 381	------	------	------	------
Virginia	13, 399	240	2, 200	([a])	9	14, 120	------	------	------	------
Washington	4, 481	2, 225	299, 861	67	135	4, 306	1, 754	50, 681	12	29
West Virginia	110, 014	49, 832	5, 348, 298	49	107	117, 300	2, 625	49, 587	([a])	19
Wyoming	9, 045	8, 607	1, 054, 227	117	122	7, 529	------	------	------	------
Other States	799	------	------	------	------	643	------	------	------	------
Total bituminous	687, 958	460, 589	53, 874, 017	78	117	704, 793	61, 629	1, 239, 125	2	20
Pennsylvania anthracite	156, 849	142, 442	19, 623, 026	125	138	157, 743	135, 585	2, 629, 418	17	19
Grand total	844, 807	603, 031	73, 497, 043	87	122	862, 536	197, 214	3, 868, 543	4	20

[a] Less than half a day.

PRODUCTION CLASSIFIED BY MINING METHODS

SYSTEM OF MINING AND PERCENTAGE OF EXTRACTION

The long-wall system of mining, which is in general use in England, is little employed in the United States outside of a few districts such as Northern Illinois and Appanoose County, Iowa, where peculiar conditions of roof make it advantageous. Elsewhere the room and pillar system is generally used, either in its simplest form or modified by division of the mine into panels. Extraction of the pillars is fortunately becoming common in the Appalachians but has still made little headway in the interior fields. The engineers of the United States Coal Commission estimated the average loss represented by unrecovered coal as 34 per cent, of which 19 per cent was held to be preventable and 15 per cent unavoidable.[14]

The best practice in the Appalachian region now recovers from 85 to 90 per cent of the coal in the ground, but in large areas of the Middle West the average recovery is less than 60 per cent. The conditions forcing this low recovery are chiefly economic and are beyond the control of the individual operator.

WASTE OF COAL IN MINING

The results of the United States Coal Commission's studies of waste in mining in 10 States east of the Mississippi are summarized in the following table. The field work was done in 1923. The tonnage figures relate to the business in 1921, a year of low production. The same percentage of loss applied to the whole country in a year of ordinary activity, in which 500,000,000 tons was produced, would mean an avoidable waste of 150,000,000 tons. The loss that could be avoided if competitive conditions permitted is thus greater than the entire quantity of bituminous coal produced by present-day Germany.[15]

TABLE 39.—*Summary of coal losses in 1921 in States investigated by engineers of United States Coal Commission*

State	Production (net tons)	Loss of coal					
		Per cent			Net tons		
		Total	Avoidable	Unavoidable	Total	Avoidable	Unavoidable
Alabama	12, 600, 000	32. 9	18. 0	14. 9	6, 150, 000	3, 370, 000	2, 780, 000
Illinois	69, 600, 000	49. 0	29. 7	19. 3	66, 900, 000	40, 550, 000	26, 350, 000
Indiana	20, 300, 000	42. 2	26. 7	15. 5	15, 800, 000	10, 000, 000	5, 800, 000
Kentucky	31, 600, 000	30. 7	11. 8	18. 9	14, 000, 000	5, 380, 000	8, 620, 000
Maryland	1, 827, 000	30. 7	12. 7	18. 0	808, 000	328, 000	480, 000
Ohio	31, 900, 000	40. 0	26. 0	14. 0	21, 300, 000	13, 740, 000	7, 560, 000
Pennsylvania	116, 000, 000	28. 6	15. 5	13. 1	46, 400, 000	25, 100, 000	21, 300, 000
Tennessee	4, 400, 000	24. 7	13. 2	11. 5	1, 440, 000	770, 000	670, 000
Virginia	7, 500, 000	20. 0	5. 0	15. 0	1, 870, 000	467, 000	1, 403, 000
West Virginia	72, 800, 000	22. 8	10. 5	12. 3	21, 500, 000	9, 900, 000	11, 600, 000
Total or average	368, 527, 000	34. 7	19. 4	15. 3	196, 168, 000	109, 605, 000	86, 563, 000

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[14] U. S. Coal Commission Report, vol 3, pp. 1841–1875, 1925.

[15] U. S. Coal Commission, Report on the amount and nature of losses in mining bituminous coal.

METHODS OF DIGGING THE COAL

The term "mining methods" as used in the following tables refers not to the system of mining but to the method by which the individual miner "digs" or breaks down the coal. Coal in the mine is either blasted from a solid face—"shot off the solid"—as in hard-rock mining, or is shot loose or otherwise broken down after a cut has been made in the bed.

The cut or kerf may be made either by hand with the pick or by a cutting machine. The term "mined by hand" as here used includes not only the coal undercut by hand but also coal recovered in certain long-wall districts where the pressure of the roof helps to bring down the coal with a minimum of cutting and shooting. The term "mined by machine" refers to the several types of cutting machines, and not to the mechanical loader, the use of which is discussed on page 588.

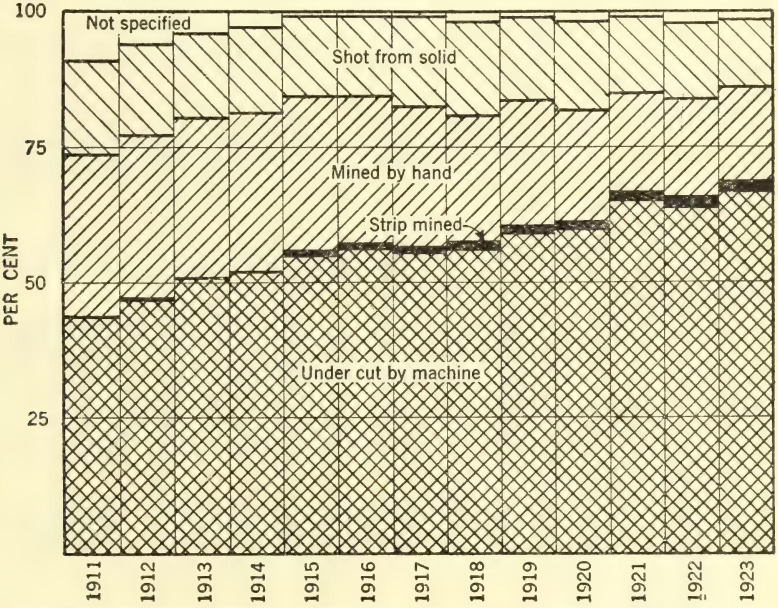

FIGURE 39.—Per cent of total bituminous output mined by different methods, 1911–1923. The record for strip mines does not begin until 1915. The large percentage "not specified" prior to 1915 consists partly of strip-mined coal but chiefly of coal shot off the solid or mined by hand

In mining from strip pits, a form of open-pit mining, the overburden is removed by a steam shovel or some equivalent device, and the coal thus exposed is shot and then loaded into cars by hand or more commonly by the steam shovel.

In the term "not specified" are included all operations not furnishing this information. Most of them are small (see Table 40), and their output is undoubtedly either mined by hand or shot off the solid.

The 13 years during which the Geological Survey has collected statistics on this subject have witnessed a steady growth in the proportion mined by cutting machines, and a corresponding decrease in the percentage shot off the solid and particularly in that mined by hand (fig. 39).

TABLE 40.—*Bituminous coal mined by different methods, 1922–23*

State	Mined by hand		Shot off the solid		Mined by machines		From strip pits		Not specified		Total production (net tons)
	Net tons	Percentage	Net tons	Percentage	Net tons	Percentage	Net tons	Percentage	Net tons	Percentage	
1922											
Alabama	3, 654, 253	19. 9	6, 907, 192	37. 7	7, 265, 408	39. 7	375, 166	2. 0	122, 721	0. 7	18, 324, 740
Arkansas	42, 307	3. 8	798, 440	71. 9	171, 426	15. 5	39, 761	3. 6	58, 112	5. 2	1, 110, 046
Colorado	4, 217, 871	42. 1	617, 786	6. 2	5, 051, 340	50. 4	2, 700		129, 900	1. 3	10, 019, 597
Georgia			20, 600	34. 0			40, 036	66. 0			60, 636
Illinois	3, 152, 543	5. 4	15, 257, 280	26. 1	38, 952, 697	66. 6	720, 060	1. 2	385, 156	. 7	58, 467, 736
Indiana	1, 258, 355	6. 6	6, 694, 581	35. 0	9, 539, 004	49. 8	1, 374, 715	7. 2	266, 234	1. 4	19, 132, 889
Iowa	783, 502	18. 0	2, 878, 096	66. 4	588, 877	13. 6			84, 686	2. 0	4, 335, 161
Kansas	116, 183	3. 9	2, 136, 119	72. 3	95, 152	3. 2	404, 947	13. 7	202, 769	6. 9	2, 955, 170
Kentucky	1, 766, 963	4. 2	5, 355, 037	12. 7	33, 322, 271	79. 1	468, 845	1. 1	1, 221, 059	2. 9	42, 134, 175
Maryland	691, 172	56. 5	174, 625	14. 3	303. 070	24. 8			53, 840	4. 4	1, 222, 707
Michigan	500	. 1	35, 510	3. 8	893, 380	96. 1					929, 390
Missouri	355, 821	12. 1	756, 672	25. 9	871, 466	29. 8	833, 427	28. 5	107, 364	3. 7	2, 924, 750
Montana	564, 489	21. 9	532, 244	20. 7	1, 433, 602	55. 8			41, 886	1. 6	2, 572, 221
New Mexico	1, 589, 120	50. 5	529, 068	16. 8	986, 417	31. 3			42, 568	1. 4	3, 147, 173
North Dakota	13, 882	1. 0	400, 325	30. 2	442, 436	33. 3	274, 722	20. 7	196, 199	14. 8	1, 327, 564
Ohio	753, 100	2. 8	675, 978	2. 5	21, 683, 670	80. 5	3, 156, 615	11. 7	684, 428	2. 5	26, 953, 791
Oklahoma	15, 397	. 5	1, 008, 307	36. 0	1, 398, 535	49. 9	321, 580	11. 5	58, 692	2. 1	2, 802, 511
Pennsylvania	37, 894, 142	33. 5	4, 213, 465	3. 7	65, 619, 223	58. 0	1, 951, 316	1. 7	3, 470, 162	3. 1	113, 148, 308
Tennessee	665, 757	13. 6	2, 661, 860	54. 6	1, 435, 530	29. 5	6, 411	. 1	107, 216	2. 2	4, 876, 774
Texas	755, 378	68. 3	284, 412	25. 7	47, 217	4. 3			19, 000	1. 7	1, 106, 007
Utah	973, 697	19. 5	200, 824	4. 0	3, 816, 537	76. 5			950		4, 992, 008
Virginia	511, 515	4. 9	2, 371, 657	22. 6	7, 541, 631	71. 9			66, 371	. 6	10, 491, 174
Washington	1, 179, 153	45. 7	1, 032, 724	40. 0	330, 141	12. 8			39, 147	1. 5	2, 581, 165
West Virginia	15, 335, 166	19. 1	2, 650, 315	3. 3	61, 763, 445	76. 7	179, 841	. 2	559, 425	. 7	80, 488, 192
Wyoming	900, 866	15. 1	1, 530, 316	25. 6	3, 451, 956	57. 8	75, 000	1. 3	13, 586	. 2	5, 971, 724
Other States	53, 107	27. 6	103, 111	53. 6	28, 500	14. 8			7, 772	4. 0	192, 490
	77, 244, 239	18. 3	59, 826, 544	14. 2	267, 032, 931	63. 2	10, 225, 142	2. 4	7, 939, 243	1. 9	422, 268, 099
1923											
Alabama	3, 740, 428	18. 3	7, 241, 565	35. 4	8, 716, 291	42. 6	545, 102	2. 7	214, 263	1. 0	20, 457, 649
Alaska	11, 983	10. 0	107, 843	90. 0							119, 826
Arkansas	30, 130	2. 3	839, 070	64. 7	189, 861	14. 6	154, 731	12. 0	83, 100	6. 4	1, 296, 892
Colorado	4, 430, 770	42. 8	894, 033	8. 7	4, 896, 915	47. 3			124, 500	1. 2	10, 346, 218
Georgia	2, 400	3. 2	21, 681	28. 7			50, 589	66. 9	950	1. 2	75, 620
Illinois	4, 618, 236	5. 8	18, 936, 803	23. 9	54, 170, 999	68. 3	1, 283, 044	1. 6	300, 993	. 4	79, 310, 075
Indiana	1, 017, 529	3. 9	8, 278, 979	31. 6	14, 234, 398	54. 3	2, 289, 887	8. 7	408, 306	1. 5	26, 229, 099
Iowa	1, 011, 345	17. 7	3, 447, 076	60. 4	1, 181, 342	20. 7			70, 972	1. 2	5, 710, 735

Kansas	104, 164	2. 3	3, 445, 664	77. 6	97, 941	2. 2	651, 155	14. 7	144, 225	3. 2	4, 443, 149
Kentucky	1, 569, 655	3. 5	4, 143, 137	9. 3	37, 710, 934	84. 2	844, 003	1. 9	509, 588	1. 1	44, 777, 317
Maryland	1, 410, 336	61. 7	255, 939	11. 2	582, 734	25. 5	----------	----------	36, 917	1. 6	2, 285, 926
Michigan	----------	----------	81, 238	6. 9	1, 086. 337	92. 7	----------	----------	4, 500	. 4	1, 172, 075
Missouri	481, 472	14. 1	955, 100	28. 1	1, 005, 756	29. 6	845, 143	24. 8	115, 680	3. 4	3, 403, 151
Montana	785, 925	25. 0	842, 054	26. 7	1, 495, 902	47. 5	----------	----------	23, 797	. 8	3, 147, 678
New Mexico	1, 364, 383	46. 8	670, 840	23. 0	851, 705	29. 2	----------	----------	28, 245	1. 0	2, 915, 173
North Dakota	20, 797	1. 5	373, 175	26. 9	426, 008	30. 8	376, 384	27. 2	189, 036	13. 6	1, 385, 400
Ohio	650, 361	1. 6	654, 651	1. 6	35, 877, 385	88. 5	2, 988, 819	7. 4	375, 227	. 9	40, 546, 443
Oklahoma	58, 176	2. 0	816, 556	28. 3	1, 636, 668	56. 7	313, 471	10. 9	60, 167	2. 1	2, 885, 038
Pennsylvania	54, 503, 203	31. 7	4, 315, 347	2. 5	110, 326, 052	64. 1	1, 299, 166	. 8	1, 436, 145	. 9	171, 879, 913
Tennessee	923, 021	15. 3	3, 002, 172	49. 7	1, 999, 345	33. 1	1, 704	----------	114, 026	1. 9	6, 040, 268
Texas	690, 535	58. 1	371, 222	31. 3	44, 519	3. 8	----------	----------	81, 053	6. 8	1, 187, 329
Utah	1, 175, 487	24. 9	322, 905	6. 8	3, 221, 425	68. 3	----------	----------	400	----------	4, 720, 217
Virginia	511, 564	4. 4	2, 520, 870	21. 4	8, 645, 351	73. 5	----------	----------	83, 858	. 7	11, 761, 643
Washington	1, 605, 634	54. 9	1, 025, 617	35. 1	252, 880	8. 6	----------	----------	42, 261	1. 4	2, 926, 392
West Virginia	17, 895, 509	16. 6	4, 179, 989	3. 9	84, 986, 380	78. 7	296, 936	. 3	541, 127	. 5	107, 899, 941
Wyoming	1, 001, 323	13. 2	2, 764, 456	36. 5	3, 793, 415	50. 1	----------	----------	15, 837	. 2	7, 575, 031
Other States	23, 769	35. 7	27, 306	41. 1	5, 000	7. 6	----------	----------	10, 389	15. 6	66, 464
	99, 638, 135	17. 6	70, 535, 288	12. 5	377, 435, 543	66. 9	11, 940, 134	2. 1	5, 015, 562	. 9	564, 564, 662

The percentage shot from the solid declined from 17 in 1911 to 12.5 in 1923. The influences that have brought about the change are partly humanitarian and partly economic. The heavy charges of powder weaken the roof and pillars and thus increase the danger of falls of roof and coal, the most prolific source of fatal accidents to coal miners. Another objection to this method, based upon commercial rather than humanitarian considerations, is that the heavy charges of explosives required to blow down coal that has not been undercut or sheared produce a much higher proportion of fine or small coal and make the lump coal so friable that it disintegrates in handling and in transportation. The growing use of mechanical stokers and the developments made in the use of powdered coal have robbed this objection of much of its force, but the danger to the mine and to the workers still continues, and in some States shooting from the solid is forbidden by law.

The decline in the percentage mined by hand from 29.7 in 1911 to 17.6 in 1923 is due almost entirely to economic influences. Machine cutting makes possible a much greater output per man and it has tended to replace cutting by hand wherever the natural conditions permit and the differential between the wage rate for pick mining and the combined rate for cutting and loading is sufficient to cover the cost of the machine. In consequence, the proportion mined by machine rose from less than half in 1911 to two-thirds in 1923.

In rate of growth the proportion mined by stripping has exceeded even that by machine cutting. In 1915, when the first statistics on the subject were collected, the strip pits produced 0.6 per cent of the total; in 1923 their contribution was 2.1 per cent, or more than three times as much. The use of stripping has been stimulated by high wage rates prevailing in the union fields and by the greater output per man per day which it makes possible.

The relative proportions mined by the several methods differ greatly from State to State (Table 40).

Solid shooting remains the dominant method in Kansas, Arkansas, Iowa, and Tennessee, where from 77.6 to 49.7 per cent of the product in 1923 was obtained in this way. In the southern Appalachians and Virginia it is still largely used. In the northern and middle Appalachians it is seldom reported. Operators in the fields of the interior and in the Far West, outside of Michigan, Utah, and Colorado, still employ it extensively. The States from which the smallest percentages were reported in 1923 were Ohio (1.6 per cent), Pennsylvania (2.5 per cent), and West Virginia (3.9 per cent).

Mining by hand remains the dominant method in Maryland, New Mexico, Texas, and Washington, all States where either natural conditions, the age of the workings, or cheap labor make the substitution of solid shooting or machine cutting less advantageous than elsewhere.

In 16 out of the 26 States shown in Table 40 more coal is now mined with cutting machines than by any other method. Michigan and Ohio lead, with 92.7 and 88.5 per cent respectively, followed by Kentucky (84.2), West Virginia (78.7), Virginia (73.5), Illinois (68.3), and Utah (68.3). Kansas, with 2.2 per cent, shows the smallest proportion mined by machine of all the important producing States.

Strip mining is confined to the outcrops of flat or gently dipping beds in the interior fields or on the western edge of the northern Appalachians, where considerable areas of coal lie within a few feet of a level surface.

COAL-CUTTING MACHINES

The number of coal-cutting machines of all types in use in the bituminous-coal mines in 1923 was 21,229, an increase of 793 over the number in 1922. The average output per machine, which depends more on the number of days worked than on the size of the machines, was 17,779 tons in 1923, about the same as in the war years and in 1920. By States the data are given in Table 41.

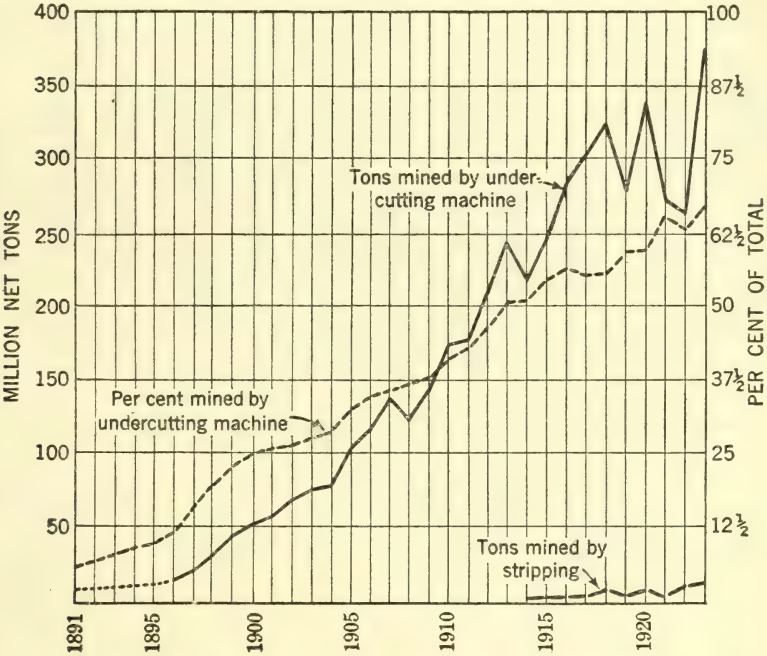

FIGURE 40.—Bituminous coal produced by undercutting machines and strip pits, 1891–1923

The year 1923 set a new record in total quantity mined by cutting machines—377,435,000 tons, against 339,813,000 tons in 1920, the highest figure previously attained. The growth of machine-mined tonnage since 1891, when the statistics were first collected, is shown in Table 42 and Figure 40.

In the anthracite mines of Pennsylvania the physical conditions are ill adapted to the use of cutting machines, and the quantity won by machines is small. In 1923 it was 1,079,055 gross tons (Table 43), considerably more than in 1920 and 1921, but less than in the war years.

TABLE 41.—*Number of coal-cutting machines in bituminous-coal mines, average output per machine, and per cent of total product mined by machines, 1913, 1922, and 1923*

State	Number of coal-cutting machines in use			Average output per machine			Percentage of total product cut by machines		
	1913	1922	1923	1913	1922	1923	1913	1922	1923
Alabama	377	355	395	10, 940	20, 466	22, 067	23. 3	39. 7	42. 6
Arkansas	27	45	40	9, 300	3, 809	4, 767	11. 2	15. 5	14. 6
California	2			600			4. 8		
Colorado	300	455	440	7, 705	11, 102	11, 129	25. 0	50. 4	47. 3
Illinois	1, 845	2, 841	3, 151	17, 686	13, 710	17, 191	53. 0	66. 6	68. 3
Indiana	732	797	852	13, 302	11, 969	16, 707	56. 7	49. 8	54. 3
Iowa	28	91	81	4, 311	6, 471	14, 584	1. 6	13. 6	20. 7
Kansas	9	17	22	2, 458	5, 597	4, 452	. 3	3. 2	2. 2
Kentucky	1, 263	1, 784	1, 928	11, 365	18, 678	19, 559	73. 2	79. 1	84. 2
Maryland	13	31	47	6, 384	9, 776	12, 398	1. 7	24. 8	25. 5
Michigan	130	88	80	6, 636	10, 152	13, 579	70. 0	96. 1	92. 7
Missouri	104	132	135	8, 307	6, 602	7, 450	20. 0	29. 8	29. 6
Montana	97	84	95	11, 099	17, 067	15, 746	33. 2	55. 8	47. 5
New Mexico	44	107	107	11, 297	9, 219	7, 960	13. 4	31. 3	29. 2
North Carolina		1	1		28, 500	5, 000		14. 8	13. 9
North Dakota	13	20	25	17, 094	22, 122	17, 040	44. 9	33. 3	30. 8
Ohio	1, 681	2, 342	2, 351	19, 418	9, 258	15, 260	90. 2	80. 5	88. 5
Oklahoma	103	207	183	6, 511	6, 756	8, 943	16. 1	49. 9	56. 7
Pennsylvania	6, 301	6, 337	6, 481	14, 678	10, 355	17, 020	53. 2	58. 0	64. 1
Tennessee	252	180	171	7, 312	7, 975	11, 692	26. 7	29. 5	33. 1
Texas	24	4	5	4, 204	11, 804	8, 904	4. 2	4. 3	3. 8
Utah	50	183	192	12, 510	20, 855	16, 778	19. 2	76. 5	68. 3
Virginia	187	264	277	22, 497	28, 566	31, 210	47. 6	71. 9	73. 5
Washington	63	27	26	4, 453	12, 227	9, 726	7. 2	12. 8	8. 6
West Virginia	2, 539	3, 809	3, 936	15, 500	16, 214	21, 592	55. 3	76. 7	78. 7
Wyoming	195	235	208	15, 645	14, 689	18, 237	41. 3	57. 8	50. 1
	16, 379	20, 436	21, 229	14, 801	13, 067	17, 779	50. 7	63. 2	66. 9

TABLE 42.—*Bituminous coal mined by undercutting machines, 1891–1923*

Year	Machines in use	Quantity mined by undercutting machines (net tons)		Year	Machines in use	Quantity mined by undercutting machines (net tons)	
		Total	Average per machine			Total	Average per machine
1891	545	6, 211, 732	11, 398	1910	13, 254	174, 012, 293	13, 127
1896	1, 446	16, 424, 932	11, 373	1911	13, 829	178, 158, 236	12, 854
1897	1, 956	22, 649, 220	11, 579	1912	15, 298	210, 538, 822	13, 763
1898	2, 622	32, 413, 144	12, 362	1913	16, 379	242, 421, 713	14, 801
1899	3, 125	43, 963, 933	14, 068	1914	16, 507	218, 399, 287	13, 231
1900	3, 907	52, 784, 523	13, 510	1915	15, 692	243, 237, 551	15, 501
1901	4, 341	57, 843, 335	13, 325	1916	16, 198	283, 691, 475	17, 514
1902	5, 418	69, 611, 582	12, 848	1917	17, 235	306, 396, 127	17, 777
1903	6, 658	77, 974, 894	11, 712	1918	18, 463	323, 931, 133	17, 545
1904	7, 663	78, 606, 997	10, 258	1919	18, 959	276, 019, 799	14, 559
1905	9, 184	103, 396, 452	11, 258	1920	19, 103	339, 813, 476	17, 788
1906	10, 212	118, 847, 527	11, 638	1921	19, 618	272, 702, 389	13, 901
1907	11, 144	138, 547, 823	12, 432	1922	20, 436	267, 032, 931	13, 067
1908	11, 569	123, 183, 334	10, 648	1923	21, 229	377, 435, 543	17, 779
1909	13, 049	142, 496, 878	10, 920				

TABLE 43.—*Pennsylvania anthracite mined by undercutting machines, 1916–1923*

Year	Gross tons	Year	Gross tons
1916	1, 642, 416	1920	837, 565
1917	1, 745, 735	1921	874, 237
1918	1, 658, 495	1922	448, 922
1919	1, 406, 433	1923	1, 079, 055

STRIP PITS

In 1923, for the second year in succession, the production of bituminous coal from steam-shovel pits set a new record. Although the total output of soft coal fell short of that for 1920, the output of strip-mined coal showed an increase of 33 per cent (Table 44). The production of strip coal in Ohio and Pennsylvania declined slightly, but in Illinois, Indiana, and western Kentucky it showed a very large increase. The anthracite region continued to produce about the same quantity as in other recent years of normal output.

TABLE 44.—*Coal recovered from steam-shovel strip pits, 1914–1923*

Year	Pennsylvania anthracite		Bituminous coal		Total	
	Number of shovels	Coal mined (net tons)	Number of shovels	Coal mined (net tons)	Number of shovels	Coal mined (net tons)
1914	(a)	(a)	48	1, 280, 946	48	1, 280, 946
1915	57	1, 121, 603	87	2, 831, 619	144	3, 953, 222
1916	105	1, 987, 800	111	3, 933, 395	216	5, 921, 195
1917	76	2, 301, 588	182	5, 789, 977	258	8, 091, 565
1918	82	2, 360, 183	276	8, 288, 245	358	10, 648, 428
1919	89	2, 006, 879	287	5, 634, 951	376	7, 641, 830
1920	96	2, 054, 441	312	8, 859, 553	408	10, 913, 994
1921	85	2, 027, 790	279	4, 699, 511	364	6, 727, 301

State	1922		1923	
	Number of shovels	Coal mined (net tons)	Number of shovels	Coal mined (net tons)
Alabama	15	368, 820	19	541, 095
Arkansas	3	27, 347	11	153, 381
Georgia	---------	-----------	1	50, 589
Illinois	23	706, 360	29	1, 256, 704
Indiana	50	1, 366, 015	61	2, 282, 462
Kansas	19	389, 996	26	647, 715
Kentucky	15	468, 845	22	844, 003
Missouri	32	833, 147	30	844, 977
North Dakota	5	198, 851	10	350, 584
Ohio	108	3, 055, 844	118	2, 975, 370
Oklahoma	14	320, 080	17	313, 075
Pennsylvania (bituminous)	83	1, 895, 490	84	1, 292, 970
Tennessee	1	6, 411	1	1, 704
West Virginia	8	174, 225	13	289, 718
Wyoming	3	75, 000	---------	-----------
Total bituminous	379	9, 886, 431	442	11, 844, 347
Pennsylvania anthracite	69	949, 745	95	2, 263, 098
Grand total	448	10, 836, 176	537	14, 107, 445

[a] Not available.

The growing number of strip pits and the peculiar character of their operation make it advisable to present statistics of labor for such mines separate from the deep mines. Table 45 is a summary of the reports of all stripping operations that produced bituminous coal in 1923. As some companies develop their coal lands by stripping along the outcrops and by underground methods where the cover becomes thicker, it is not always possible to separate the particulars relating to stripping from the particulars relating to deep mining. Hence the table shows a considerable number of men employed underground, and the figures of days worked and the computed average output per man per day embrace their activities as well as those of the men engaged exclusively in stripping work on the surface.

The number of strip pits that produced coal in 1923 was 263. The number of shovels was 442, an average of somewhat less than 2 shovels to the pit. The quantity mined by stripping was 11,940,000 tons. Including coal recovered from underground operations the total output of the operations as a whole was 15,348,000 tons. The value of the strip coal proper can not be separated from the value of this coal won underground, but the total value of the entire product was $37,044,000, an average of $2.41 a ton. The lower costs of stripping are indicated by the fact that the average for all bituminous coal produced in 1923 was $2.68 a ton.

The total number employed by the operations embraced in the table was 12,654 men, of whom 9,332 worked on the surface.

The indicated production per man per day for the group of mines as a whole computed from the total quantity produced and the total number of men employed was 7.5 tons. Large as this figure seems in comparison with the 4.48 tons that represents the average for all mines in 1923, it is doubtless less than the actual daily production per man from the stripping operations alone could they be accurately segregated from the associated underground work. An approximation of the daily output per worker actually engaged in stripping may be had by dividing the tons mined by stripping by the product of the total number employed on the surface and the average days worked. This computation yields an average of 7.94 tons per man per day, a figure that agrees closely with the results of a special analysis of the production by methods of mining made in 1921 and published in the report on coal in 1922.[16]

This higher production per man per day is the clue to the rapid increase in the number and output of strip mines in recent years. High levels of wages, particularly in the union districts, have placed a premium upon economy in labor and favored the substitution of machine for hand methods.

The strip mines, however, suffer a disadvantage in being more subject to interruption by bad weather, whether violent storms in summer or heavy snows in winter; consequently, the average time worked by strip mines is less than the time of deep mines. The average for the 263 operations shown in Table 45 was 161 days; the average for all mines in the country 179 days. The location of stripping operations is governed by the occurrence of gently dipping beds of coal overlain by a few feet of cover in level country. The areas thus adapted to the method are the outcrops of the coal measures of the interior field and corresponding areas in the Pittsburgh and eastern Ohio fields. An interesting development is the rapid growth of stripping in the North Dakota lignite area, where ten pits produced in 1923 a total of 376,000 tons.

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[16] U. S. Geol. Survey Mineral Resources, 1922, pt. 2, p. 509, 1924.

TABLE 45.—*Summary of stripping operations that produced bituminous coal in 1923*

[For mines that recover coal both by stripping and by underground operations, the returns do not permit separating men engaged in stripping from those engaged in other work. For this reason the figures of men employed represent all persons working at these mines, including those underground. The total quantity produced by both methods at these same mines is also shown]

State and county	Number of strip pits	Number of shovels	Coal produced (net tons)		Total value at same mines	Men employed—				Days worked	Per cent of county or State total that was mined by stripping
			Mined by stripping	Total at same mines		Underground		Surface	Total		
						Miners, etc.	All others				
Alabama:											
Jefferson and Walker	11	19	545, 102	757, 052	$1, 811, 359	335	113	513	961	202	3. 4
Arkansas:											
Franklin	4	7	102, 202	102, 202	322, 651			188	188	114	40. 2
Johnson and Sebastian	6	4	52, 529	52, 529	233, 572	2	2	101	105	80	6. 4
	10	11	154, 731	154, 731	556, 223	2	2	289	293	102	12. 0
Georgia:											
Walker	1	1	50, 589	72, 270	313, 136	59	19	69	147	251	66. 9
Illinois:											
Vermilion	8	15	824, 925	907, 883	2, 153, 345	56	21	455	532	195	19. 8
Williamson	4	8	128, 967	128, 967	293, 007			98	98	74	1. 2
Fulton, Jackson, La Salle, Livingston, Perry, and Saline	6	6	329, 152	331, 259	818, 257	9	1	171	181	142	2. 8
	18	29	1, 283, 044	1, 368, 109	3, 264, 609	65	22	724	811	169	1. 6
Indiana:											
Clay	7	11	373, 955	373, 955	771, 512	1	1	203	205	150	57. 9
Greene	8	14	479, 701	479, 701	1, 060, 860			354	354	118	20. 0
Pike	5	14	705, 480	721, 480	1, 496, 998	50	20	392	462	121	38. 8
Vigo	3	4	15, 170	15, 170	34, 942			54	54	53	. 2
Warrick	3	9	423, 441	423, 441	833, 762			285	285	218	42. 9
Owen, Sullivan, and Vermilion	5	9	292, 140	292, 140	725, 943			268	268	145	3. 3
	31	61	2, 289, 887	2, 305, 887	4, 924, 017	51	21	1, 556	1, 628	143	8. 7

TABLE 45.—*Summary of stripping operations that produced bituminous coal in 1923*—Continued

State and county	Number of strip pits	Number of shovels	Coal produced (net tons)		Total value at same mines	Men employed—				Days worked	Per cent of county or State total that was mined by stripping
			Mined by stripping	Total at same mines		Underground		Surface	Total		
						Miners, etc.	All others				
Kansas:											
Cherokee	8	14	332, 774	332, 774	925, 367	----------	----------	201	201	99	45. 9
Crawford	9	12	318, 381	335, 358	1, 015, 186	27	6	255	288	144	9. 3
	17	26	651, 155	668, 132	1, 940, 553	27	6	456	489	126	14. 7
Kentucky:											
Hopkins	5	13	635, 506	635, 506	1, 073, 024	----------	----------	284	284	190	23. 4
Floyd, and Scott County, Tennessee	2	3	19, 704	23, 061	38, 205	45	20	25	90	63	. 6
McLean, Muhlenberg, and Webster	3	7	190, 497	190, 497	344, 472	----------	----------	135	135	79	3. 5
	10	23	845, 707	849, 064	1, 455, 701	45	20	444	509	138	1. 9
Missouri:											
Barton	16	21	675, 349	675, 349	2, 139, 885	----------	----------	683	683	96	95. 9
Bates	3	4	58, 926	58, 926	163, 728	----------	----------	80	80	95	49. 1
Boone, Henry, Johnson, St. Clair, and Vernon	6	5	110, 868	111, 868	311, 930	4	1	154	159	120	56. 6
	25	30	845, 143	846, 143	2, 615, 543	4	1	917	922	100	24. 8
North Dakota:											
Burke	5	7	227, 930	227, 930	506, 970	----------	----------	119	119	230	95. 2
Divide, Hettinger, McLean, and Mercer	5	3	148, 454	166, 988	378, 757	21	6	110	137	228	36. 5
	10	10	376, 384	394, 918	885, 727	21	6	229	256	229	27. 2
Ohio:											
Belmont	3	4	148, 246	148, 246	277, 720	----------	----------	80	80	187	1. 1
Harrison	16	34	1, 077, 165	1, 077, 165	2, 179, 495	16	6	780	802	92	38. 9
Jefferson	15	37	963, 932	1, 099, 683	2, 165, 615	120	28	786	934	116	14. 8
Muskingum	3	6	84, 748	84, 748	168, 246			95	95	66	17. 6
Perry	8	20	415, 620	415, 620	821, 996	----------	----------	349	349	106	16. 4
Tuscarawas	7	8	79, 236	91, 232	205, 538	10	3	115	128	106	5. 9
Columbiana, Guernsey, Hocking, and Vinton	5	9	219, 872	219, 872	489, 527	22	7	194	223	175	4. 0
	57	118	2, 988, 819	3, 136, 566	6, 308, 137	168	44	2, 399	2, 611	112	7. 4

Oklahoma:										
Tulsa	3	5	137, 207	137, 207	497, 419	----------	----------	150	150	235	69. 3
Haskell, Le Flore, Okmulgee, Rogers, and Wagoner	7	12	176, 264	209, 434	768, 156	38	22	164	224	216	14. 5
	10	17	313, 471	346, 641	1, 265, 575	38	22	314	374	223	10. 9
Pennsylvania:											
Allegheny	12	19	533, 738	623, 697	1, 729, 972	83	20	245	348	238	2. 6
Clearfield	6	7	45, 461	71, 451	190, 144	43	19	75	137	163	. 6
Fayette	7	11	71, 819	1, 229, 136	3, 534, 904	309	393	192	894	266	. 2
Somerset	4	5	26, 349	30, 109	63, 237	21	6	36	63	153	. 3
Washington	5	12	334, 823	632, 920	1, 325, 873	237	47	280	564	185	1. 3
Westmoreland	13	23	165, 560	549, 181	1, 196, 999	189	76	188	453	198	. 7
Beaver, Bradford, Center, Clinton, Greene, and Indiana	6	7	121, 416	348, 404	821, 911	125	37	180	342	186	. 7
	53	84	1, 299, 166	3, 484, 898	8, 863, 040	1, 007	598	1, 196	2, 801	218	. 8
Tennessee. (See Floyd County, Ky.)											
West Virginia:											
Harrison	5	8	225, 239	225, 239	599, 431	----------	----------	101	101	122	3. 2
Brooke, McDowell, Marshall, and Mineral	5	5	71, 697	738, 418	2, 241, 455	375	251	125	751	180	. 3
	10	13	296, 936	963, 657	2, 840, 886	375	251	226	852	173	. 3
Grand total	263	442	11, 940, 134	15, 348, 068	37, 044, 506	2, 197	1, 125	9, 332	12, 654	161	2. 1

MECHANICAL LOADING UNDERGROUND

The application of the power shovel to strip mining and that of the undercutting machine to the work of the underground miner are milestones in the gradual substitution of machine for hand labor in the mines. The year 1923 witnessed the first widespread attention to another machine, which promises even greater results—the underground loader. The report of the United States Coal Commission on underground management in bituminous-coal mines,[17] issued in September, 1923, brought into public notice the development of machines to replace the laborious and solitary task of shoveling coal by hand into the mine cars.

An inquiry by the Geological Survey, the results of which are probably not complete, showed that up to the end of 1923 a total of 105 machines were in use in 52 mines and that the quantity loaded by machine in 1923 was at least 2,000,000 tons. Arrangements are being made to collect regular statistics of machine loading hereafter. In the meantime the curve showing the rate of introduction of the undercutting machine (fig. 40) is of interest because it throws some light on the rate at which the loader can be introduced.

COAL-WASHING OPERATIONS

The practice of washing bituminous coal has not increased in recent years. The quantity of washed coal obtained in 1923 was 20,140,000 tons (Tables 46 and 47). Though larger than in 1920 or 1921 this was much below the record of 25,483,000 tons, established in 1917.

The statistical record of coal washed begins in 1906. From 2.7 per cent of the total output in that year the washed coal rose to a maximum of 4.8 per cent in 1914, and remained at about that level until 1917; since then it has declined (fig. 41).

Washing is carried on extensively in but few districts. In Alabama it is the dominant method of preparation, and 60.1 per cent of the output of that State in 1923 was washed coal. In Georgia, Washington, and Michigan also washing is frequently applied to the product, but in all other States the proportion washed is small. In point of quantity washed, Alabama easily held first place in 1923, with 12,285,000 tons; Pennsylvania, with 2,497,000 tons, was second; and Illinois, with 1,521,000 tons, was third.

The proportion of cleaned coal to material washed in 1923 was 90 per cent, the refuse being 10 per cent.

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[17] U. S. Coal Commission Rept., vol. 3, pp. 1893-1969, 1925.

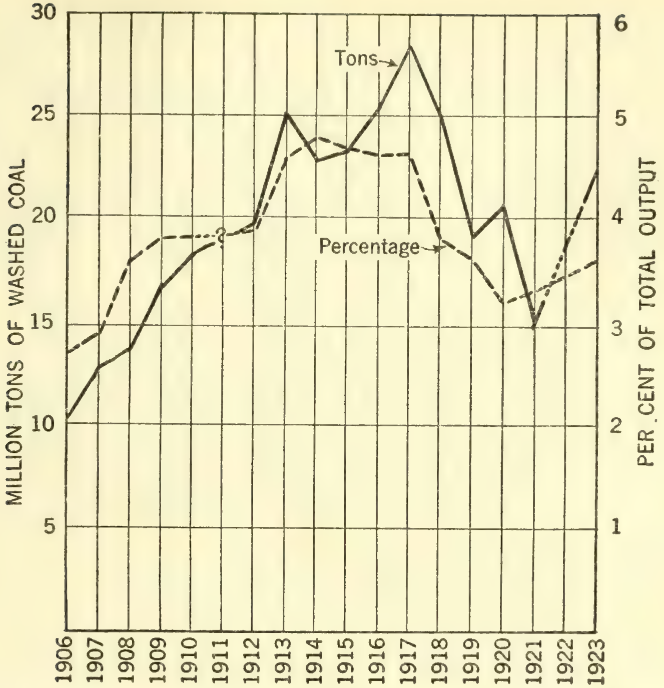

FIGURE 41.—Tonnage of washed coal and percentage of bituminous-coal output washed, 1906–1923

TABLE 46.—*Bituminous coal washed at mines, 1906–1923*

Year	Coal washed (net tons)	Cleaned coal (net tons)	Refuse (net tons)	Percentage of cleaned coal to total output
1906	10, 425, 455	9, 251, 946	1, 173, 509	2. 7
1907	12, 981, 514	11, 269, 518	1, 711, 996	2. 9
1908	13, 660, 478	11, 870, 438	1, 790, 040	3. 6
1909	16, 541, 874	14, 443, 147	2, 098, 727	3. 8
1910	18, 395, 382	16, 035, 387	2, 359, 995	3. 8
1911	(a)	(a)	(a)	(a)
1912	19, 844, 517	17, 538, 572	2, 305, 945	3. 9
1913	25, 051, 801	22, 069, 691	2, 982, 110	4. 6
1914	22, 848, 647	20, 264, 141	2, 584, 506	4. 8
1915	23, 472, 036	20, 873, 727	2, 598, 309	4. 7
1916	25, 632, 974	22, 922, 218	2, 710, 756	4. 6
1917	28, 587, 137	25, 483, 696	3, 103, 441	4. 6
1918	25, 119, 548	22, 017, 293	3, 102, 255	3. 8
1919	19, 187, 837	16, 884, 062	2, 303, 775	3. 6
1920	20, 595, 750	17, 984, 289	2, 611, 461	3. 2
1921	15, 355, 169	13, 628, 724	1, 726, 445	3. 3
1922	(b)	(b)	(b)	(b)
1923	22, 364, 986	20, 140, 385	2, 224, 601	3. 6

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[a] The returns for 1911 were apparently incomplete, but the error can not now be corrected. As published, they showed 12,355,716 tons washed and 10,830,823 tons of cleaned coal, equivalent to 2.7 per cent of the total output.

[b] Canvass not made.

TABLE 47.—*Bituminous coal washed at mines in 1923, by States*

State	Coal washed (net tons)	Cleaned coal (net tons)	Refuse (net tons)	Percentage of cleaned coal to total State output
Alabama	13, 570, 913	12, 285, 695	1, 285, 218	60. 1
Colorado	359, 638	322, 399	37, 239	3. 1
Georgia	25, 917	24, 161	1, 756	32. 0
Illinois	1, 718, 971	1, 520, 819	198, 152	1. 9
Indiana	115, 982	99, 858	16, 124	. 4
Kentucky	342, 618	306, 436	36, 182	. 7
Michigan	218, 180	197, 154	21, 026	16. 8
Missouri	118, 000	94, 950	23, 050	2. 8
Montana	214, 939	212, 297	2, 642	6. 7
Ohio	60, 944	54, 484	6, 460	. 1
Oregon	([a])	([a])	([a])	([a])
Pennsylvania	2, 705, 955	2, 496, 843	209, 112	1. 5
Tennessee	445, 975	390, 275	55, 700	6. 5
Texas	9, 549	6, 655	2, 894	. 6
Virginia	291, 874	261, 346	30, 528	2. 2
Washington	[a] 907, 339	[a] 722, 320	[a] 185, 019	[a] 24. 7
West Virginia	1, 258, 192	1, 144, 693	113, 499	1. 1
	22, 364, 986	20, 140, 385	2, 224, 601	3. 6

[a] Washington includes Oregon.

NUMBER AND SIZE OF MINES

CLASSES OF MINES, BY OUTPUT

In discussing the number of mines distinction must be made between commercial mines and the small workings known as "wagon mines," "snowbirds," and "country banks." The line between the commercial mine and the small working, however, is difficult to draw. Mere size of output is not a criterion, for some wagon mines ship rather large quantities of coal. Absence of a railroad switch is not a criterion, for this would exclude from the commercial class some large mines that ship by river or truck or that deliver their product to associated industries at the mouth of the mine.

In practice the Geological Survey has found a safer criterion to be size in conjunction with steady operation. All mines that produce 10,000 tons or more a year are classed by the Survey as "commercial mines," but the commercial class also includes much smaller mines, some of which have an annual output of 1,000 tons or less but produce year after year and show a fairly continuous existence.

Workings still smaller or less continuous in operation have been classed by the Survey as "small mines." The term is not satisfactory, however, because it is not sufficiently definite, and in the present report these workings are generally called "wagon mines," the term that in common usage most nearly describes them. A mine may be shifted from the list of commercial mines to the list of wagon mines or vice versa, as the course of the work at the mine may make such a shift advisable.

For convenience in studying production by size of mines, the Survey divides the mines into five classes. Class 1 includes mines that produce each year more than 200,000 tons; class 2, those that produce less than 200,000 and more than 100,000 tons; class 3, those that produce less than 100,000 and more than 50,000 tons; class 4, those that produce less than 50,000 and more than 10,000 tons; and class 5, those that produce less than 10,000 tons. As this classification is made according to performance, not according to capacity, the number of mines in a given class is not constant from year to year. In 1918, for example, 821 mines were listed in class 1; in 1919, 550; in 1920, 701; in 1921, 482; in 1922, 416; and in 1923, 748. These fluctuations do not indicate a corresponding change from year to year in the number of mines having the acreage and the development that would enable them to produce annually 200,000 tons or more, but they do indicate that in a given year only the number of mines listed in class 1 were able to produce more than 200,000 tons.

MINES IN 1923

The number of mines active in each producing class varies with the condition of the coal market. A year of very high prices calls into operation thousands of small producers. Thus in 1920 the Geological Survey obtained information concerning 14,766 mines, of which 5,845 were wagon mines and country banks. In the depression of 1921 most of these small workings were closed. With the high prices that followed the strike of 1922, thousands of them reopened, and the total number of mines of all sizes of which the Survey could obtain records in that year was 14,150. By the end of 1922, however, the spot price was rapidly declining and the small operations were already beginning to close. Thus although the spot price stood at $4.38 in January, 1923, it soon fell to a level so low that many commercial mines found it difficult to operate, and by midsummer wagon-mine coal had again disappeared from the market. The lower prices of 1923 are revealed by the total number of mines recorded as in operation—11,715, as against 14,150 in 1922.

How these 11,715 mines were distributed among the five size classes recognized by the Geological Survey is shown in Table 49. Illinois continued to lead in the proportion of total output mined by class 1 operations. In that State 134 mines produced more than 200,000 tons in 1923; and they constituted 21.4 per cent of the total number of mines and contributed 74.8 per cent of the entire output of the State. West Virginia and Pennsylvania, though producing more coal, have relatively fewer mines of the largest size. In West Virginia class 1 mines constituted 6.8 per cent of the State total and produced 34.5 per cent of the output. The conditions of the Appalachian region, where in many places the beds now worked crop out above the water level and are readily accessible by slope and drift, favor small-scale development, whereas on the plains of the Middle West the necessity of sinking shafts puts a premium upon larger operations. Other States in which class 1 mines contributed the major portion of the output were Indiana, Montana, Pennsylvania, Utah, and Virginia. The average production of class 1 mines throughout the United States was 355,440 tons in 1923.

The immense number of small mines has given rise to an exaggerated idea of their importance as suppliers of coal. In comparison with most other years 1923 was favorable to their operation, yet as will be seen from Figure 42, although mines of class 5 constituted about 52 per cent of the total number, they produced but 2 or 3 per cent of the total output. In other words, even if all the 6,114 mines in class 5 were closed or permanently abandoned the potential output of the country would be reduced by less than 3 per cent. Moreover, if all mines of class 4 (producing from 10,000 to 50,000 tons) should also be abandoned, only 15 per cent of the 1923 output would be withdrawn from the market. The closing of every operation in class 4 and class 5, though leaving only 24 per cent of the number of mines active in 1923, would leave 85 per cent of the production and presumably at least 85 per cent of the potential capacity of the country. It is therefore clear that elimination of the wagon mines would have practically no effect on the potential capacity and that the closing of even all mines producing less than 50,000 tons annually would fail to provide full-time operation for those remaining.

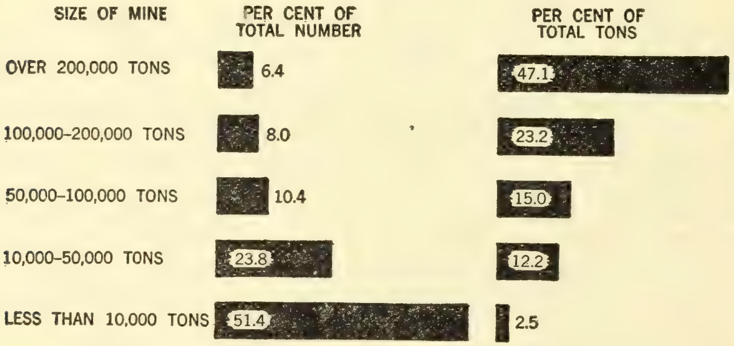

FIGURE 42.—Relative numbers and production of large and small bituminous-coal mines. Although the class 1 mines, with an individual output of 200,000 tons or over, constituted only 6.4 per cent of the total number, they produced 47.1 per cent of the total output in 1923. The very large number of small mines—52 per cent of the total number—furnished only 3 per cent of the output

TABLE 48.—*Number and production of bituminous-coal mines (including wagon mines) in 1922, by classes*

State	Class 1 (more than 200,000 tons)					Class 2 (100,000 to 200,000 tons)					Class 3 (50,000 to 100,000 tons)				
	Mines		Production			Mines		Production			Mines		Production		
	Number	Percentage	Total (net tons)	Average per mine (net tons)	Percentage	Number	Percentage	Total (net tons)	Average per mine (net tons)	Percentage	Number	Percentage	Total (net tons)	Average per mine (net tons)	Percentage
Alabama	18	4.8	6,873,000	381,834	37.5	40	10.7	5,295,000	132,375	28.9	46	12.3	3,297,000	71,674	18.0
Alaska, California, Idaho, and Oregon															
Arkansas											3	2.3	190,000	63,333	17.1
Colorado	14	5.4	3,974,000	283,857	39.7	16	6.2	2,158,000	134,875	21.5	28	10.8	1,960,000	70,000	19.6
Georgia											1	100.0	61,000	61,000	100.0
Illinois	103	13.5	36,725,000	356,553	62.8	91	11.9	12,716,000	139,736	21.7	69	9.0	5,082,000	73,652	8.7
Indiana	23	4.6	6,667,000	289,870	34.8	46	9.2	6,411,000	139,370	33.5	43	8.6	3,140,000	73,023	16.4
Iowa	2	.9	460,000	230,000	10.6	7	3.4	876,000	125,143	20.2	20	9.7	1,371,000	68,550	31.7
Kansas						2	.7	236,000	118,000	8.0	17	6.3	1,157,000	68,059	39.1
Kentucky	25	1.1	8,160,000	326,400	19.4	97	4.4	13,604,000	140,247	32.3	126	5.7	9,575,000	75,992	22.7
Maryland						1	.8	112,000	112,000	9.2	6	5.1	370,000	61,667	30.3
Michigan						2	15.4	346,000	173,000	37.2	6	46.2	458,000	76,333	49.3
Missouri						1	.5	188,000	188,000	6.4	15	6.8	1,028,000	68,533	35.1
Montana	3	4.5	1,173,000	391,000	45.6	4	6.1	612,000	153,000	23.8	6	9.1	454,000	75,667	17.6
New Mexico	2	3.5	625,000	312,500	19.9	17	29.8	1,976,000	116,235	62.8	6	10.5	387,000	64,500	12.3
North Carolina											1	50.0	57,000	57,000	72.2
North Dakota	1	.7	249,000	249,000	18.7						5	3.5	327,000	65,400	24.6
Ohio	11	.7	2,888,000	262,545	10.7	68	4.5	9,167,000	134,809	34.0	85	5.1	6,389,000	75,164	23.7
Oklahoma						4	2.4	449,000	112,250	16.0	14	8.3	924,000	66,000	33.0
Pennsylvania	105	2.4	31,781,000	302,676	28.1	216	4.9	29,988,000	138,833	26.5	292	6.6	20,289,000	69,483	17.9
South Dakota															
Tennessee	1	.4	215,000	215,000	4.4	11	4.5	1,441,000	131,000	29.5	14	5.7	1,016,000	72,571	20.8
Texas						1	2.5	121,000	121,000	10.9	2	5.1	123,000	61,500	11.1
Utah	9	20.9	2,909,000	323,222	58.3	10	23.3	1,653,000	165,300	33.1	4	9.3	280,000	70,000	5.6
Virginia	19	7.9	5,996,000	315,579	57.1	13	5.4	1,868,000	143,692	17.8	12	5.0	766,000	63,833	7.3
Washington	3	6.3	724,000	241,333	28.1	9	18.8	1,199,000	133,222	46.5	4	8.3	269,000	47,250	10.4
West Virginia	71	3.6	20,970,000	295,352	26.1	170	8.5	23,809,000	140,053	29.6	242	12.2	17,031,000	70,376	21.2
Wyoming	6	7.7	1,487,000	247,833	24.9	22	28.2	2,970,000	135,000	49.7	17	21.8	1,286,000	75,647	21.6
	416	2.9	131,876,000	317,010	31.2	848	6.0	117,195,000	138,202	27.8	1,084	7.7	77,287,000	71,298	18.3

TABLE 48.—*Number and production of bituminous-coal mines (including wagon mines) in 1922, by classes*—Continued

State	Class 4 (10,000 to 50,000 tons)					Class 5 (less than 10,000 tons)					Total		
	Mines		Production			Mines		Production			Mines	Production (net tons)	
	Number	Percentage	Total (net tons)	Average per mine (net tons)	Percentage	Number	Percentage	Total (net tons)	Average per mine (net tons)	Percentage		Total	Average per mine
Alabama	96	25.7	2,458,000	25,604	13.4	174	46.5	402,000	2,310	2.2	374	18,325,000	48,997
Alaska, California, Idaho, and Oregon	3	18.7	86,000	28,667	81.1	13	81.3	20,000	1,538	18.9	16	106,000	6,625
Arkansas	28	21.5	613,000	21,893	55.2	99	76.2	307,000	3,101	27.7	130	1,110,000	8,538
Colorado	59	22.6	1,519,000	25,746	15.1	143	55.0	409,000	2,860	4.1	260	10,020,000	38,538
Georgia	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	61,000	61,000
Illinois	124	16.2	3,206,000	25,855	5.5	378	49.4	738,000	1,952	1.3	765	58,467,000	76,427
Indiana	89	17.9	2,404,000	27,011	12.6	298	59.7	511,000	1,715	2.7	499	19,133,000	38,343
Iowa	56	27.1	1,371,000	24,482	31.6	122	58.9	257,000	2,107	5.9	207	4,335,000	20,942
Kansas	42	15.5	1,037,000	24,690	35.1	210	77.5	525,000	2,500	17.8	271	2,955,000	10,904
Kentucky	354	16.1	9,090,000	25,678	21.6	1,597	72.7	1,705,000	1,068	4.0	2,199	42,134,000	19,161
Maryland	24	20.3	522,000	21,750	42.6	87	73.8	219,000	2,517	17.9	118	1,223,000	10,365
Michigan	3	23.0	115,000	38,333	12.4	2	15.4	10,000	5,000	1.1	13	929,000	71,462
Missouri	63	28.4	1,354,000	21,492	46.3	143	64.3	355,000	2,483	12.2	222	2,925,000	13,176
Montana	11	16.7	249,000	22,636	9.8	42	63.6	84,000	2,000	3.2	66	2,572,000	38,970
New Mexico	4	7.0	89,000	22,250	2.8	28	49.2	70,000	2,500	2.2	57	3,147,000	55,211
North Carolina	1	50.0	22,000	22,000	27.8	-----	-----	-----	-----	-----	2	79,000	39,500
North Dakota	25	17.5	482,000	19,280	36.3	112	78.3	270,000	2,411	20.4	143	1,328,000	92,867
Ohio	275	18.3	6,255,000	22,745	23.3	1,065	70.8	2,255,000	2,117	8.3	1,504	26,954,000	17,922
Oklahoma	57	33.7	1,214,000	21,298	43.3	94	55.6	215,000	2,287	7.7	169	2,802,000	16,580
Pennsylvania	1,023	23.0	24,280,000	23,734	21.5	2,809	63.1	6,810,000	2,424	6.0	4,445	113,148,000	25,455
South Dakota	-----	-----	-----	-----	-----	16	100.0	8,000	500	100.0	16	8,000	500
Tennessee	70	28.7	1,786,000	25,514	36.7	148	60.7	419,000	2,831	8.6	244	4,877,000	19,988
Texas	30	77.0	829,000	27,633	75.0	6	15.4	33,000	5,500	3.0	39	1,106,000	28,359
Utah	4	9.3	121,000	30,250	2.4	16	37.2	29,000	1,813	.6	43	4,992,000	116,093
Virginia	63	26.3	1,580,000	25,079	15.1	133	55.4	281,000	2,113	2.7	240	10,491,000	43,713
Washington	12	25.0	308,000	25,667	11.9	20	41.6	81,000	4,050	3.1	48	2,581,000	53,771
West Virginia	618	31.2	16,042,000	25,942	19.8	880	44.5	2,636,000	2,995	3.3	1,981	80,488,000	40,630
Wyoming	5	6.4	171,000	34,200	2.9	28	35.9	58,000	2,071	.9	78	5,972,000	76,564
	3,139	22.1	77,203,000	24,595	18.3	8,663	61.3	18,707,000	2,159	4.4	14,150	422,268,000	29,842

TABLE 49.—*Number and production of bituminous coal mines (including wagon mines) in 1923, by classes*

State	Class 1 (more than 200,000 tons)					Class 2 (100,000 to 200,000 tons)					Class 3 (50,000 to 100,000 tons)				
	Mines		Production			Mines		Production			Mines		Production		
	Number	Percentage	Total (net tons)	Average per mine (net tons)	Percentage	Number	Percentage	Total (net tons)	Average per mine (net tons)	Percentage	Number	Percentage	Total (net tons)	Average per mine (net tons)	Percentage
Alabama	24	7. 6	8, 693, 515	362, 230	42. 5	38	12. 1	5, 163, 470	135, 881	25. 2	49	15. 5	3, 277, 177	66, 881	16. 0
Arkansas						1	. 7	125, 139	125, 139	9. 6	4	2. 7	277, 186	69, 297	21. 4
Colorado	15	5. 9	3, 892, 913	259, 527	37. 6	19	7. 5	2, 647, 235	139, 328	25. 6	31	12. 3	2, 175, 250	70, 169	21. 1
Georgia											1	33. 3	72, 270	72. 270	95. 6
Illinois	134	21. 4	59, 354, 052	442, 941	74. 8	82	13. 1	12, 090, 380	147, 444	15. 2	64	10. 2	4, 782, 678	74, 729	6. 1
Indiana	48	11. 9	15, 531, 713	323, 577	59. 2	34	8. 4	4, 836, 532	142, 251	18. 4	45	11. 2	3, 451, 305	76, 696	13. 1
Iowa	4	2. 4	1, 268, 408	317, 102	22. 2	11	6. 7	1, 500, 835	136, 440	26. 3	19	11. 5	1, 405, 515	73, 974	24. 6
Kansas						8	2. 1	1, 151, 141	143, 893	25. 9	23	5. 9	1, 738, 097	75, 569	39. 1
Kentucky	36	2. 9	11, 562, 395	321, 178	25. 8	110	8. 7	15, 116, 475	137, 423	33. 8	132	10. 5	9, 656, 262	73, 154	21. 6
Maryland						3	2. 0	377, 399	125, 800	16. 5	12	8. 2	849, 358	70, 780	37. 1
Michigan	2	14. 3	478, 049	239, 025	40. 8	3	21. 4	355, 619	118, 540	30. 3	2	14. 3	167, 536	83, 768	14. 3
Missouri	1	. 4	308, 332	308, 332	9. 1	4	1. 7	493, 773	123, 444	14. 5	18	7. 9	1, 222, 578	67, 921	35. 9
Montana	4	6. 5	2, 014, 523	503, 630	64. 0	3	4. 8	407, 551	135, 850	13. 0	5	8. 1	382, 093	76, 419	12. 1
New Mexico	2	3. 1	606, 105	303, 053	20. 8	14	21. 5	1, 701, 203	121, 515	58. 3	3	4. 6	224, 054	74, 685	7. 7
North Dakota	1	. 7	226, 491	226, 491	16. 3	1	. 6	113, 378	113, 378	8. 2	3	2. 1	209, 644	69, 881	15. 1
Ohio	58	4. 7	16, 473, 083	284, 018	40. 6	84	6. 8	11, 802, 563	140, 507	29. 1	76	6. 2	5, 426, 571	71, 402	13. 4
Oklahoma	1	. 6	243, 764	243, 764	8. 4	3	1. 8	493, 318	164, 439	17. 1	9	5. 4	678, 493	75, 388	23. 5
Pennsylvania	247	6. 8	92, 725, 666	375, 407	53. 9	234	6. 4	32, 933, 317	140, 741	19. 2	287	7. 9	20, 569, 474	71, 671	12. 0
Tennessee	3	1. 3	790, 556	263, 516	13. 1	11	4. 7	1, 456, 666	132, 424	24. 1	24	10. 4	1, 719, 587	71, 649	28. 5
Texas											9	20. 5	465, 463	51, 718	39. 2
Utah	10	26. 3	2, 866, 410	286, 641	60. 7	8	21. 1	1, 283, 160	160, 395	27. 2	6	15. 8	492, 000	82, 000	10. 4
Virginia	19	9. 7	7, 022, 544	369, 608	59. 7	12	6. 2	1, 820, 146	151, 678	15. 5	20	10. 2	1, 419, 589	70, 979	12. 1
Washington	4	7. 0	1, 071, 075	267, 769	36. 6	8	14. 0	1, 207, 517	150, 940	41. 3	4	7. 1	257, 827	64, 457	8. 8
West Virginia	122	6. 8	37, 183, 184	304, 780	34. 5	223	12. 4	30, 647, 525	137, 433	28. 4	318	17. 7	22, 626, 776	71, 153	21. 0
Wyoming	13	19. 4	3, 556, 360	273, 566	46. 9	21	31. 3	3, 079, 906	146, 662	40. 7	12	17. 9	795, 294	66, 275	10. 5
	748	6. 4	265, 869, 138	355, 440	47. 1	935	8. 0	130, 804, 248	139, 898	23. 2	1, 176	10. 0	84, 342, 077	71, 719	14. 9

TABLE 49.—*Number and production of bituminous coal mines (including wagon mines) in 1923, by classes*—Continued

State	Class 4 (10,000 to 50,000 tons)					Class 5 (less than 10,000 tons)					Total		
	Mines		Production			Mines		Production			Mines	Production (net tons)	
	Number	Percentage	Total (net tons)	Average per mine (net tons)	Percentage	Number	Percentage	Total (net tons)	Average per mine (net tons)	Percentage		Total	Average per mine
Alabama	108	34.3	3,021,150	27,974	14.8	96	30.5	302,337	3,149	1.5	315	20,457,649	64,945
Alaska, California, Idaho, and Oregon	4	23.5	118,877	29,719	85.0	13	76.5	21,015	1,616	15.0	17	139,892	8,229
Arkansas	29	19.9	624,843	21,546	48.2	112	76.7	269,724	2,408	20.8	146	1,296,892	8,883
Colorado	49	19.4	1,285,610	26,237	12.4	139	54.9	345,210	2,484	3.3	253	10,346,218	40,894
Georgia						2	66.7	3,350	1,675	4.4	3	75,620	25,207
Illinois	98	15.7	2,379,687	24,283	3.0	247	39.6	703,278	2,847	.9	625	79,310,075	126,896
Indiana	72	17.8	1,919,070	26,654	7.3	205	50.7	490,479	2,392	2.0	404	26,229,099	64,924
Iowa	51	30.9	1,297,474	25,441	22.7	80	48.5	238,503	2,981	4.2	165	5,710,735	34,610
Kansas	35	9.0	781,867	22,339	17.6	324	83.0	772,044	2,383	17.4	390	4,443,149	11,393
Kentucky	267	21.3	7,226,330	27,065	16.1	711	56.6	1,215,855	1,710	2.7	1,256	44,777,317	35,651
Maryland	32	21.9	817,464	25,546	35.9	99	67.9	241,705	2,441	10.5	146	2,285,926	15,657
Michigan	5	35.7	166,371	33,274	14.2	2	14.3	4,500	2,250	.4	14	1,172,075	83,720
Missouri	42	18.3	984,340	23,437	28.9	164	71.7	394,128	2,403	11.6	229	3,403,151	14,861
Montana	9	14.5	241,003	26,778	7.7	41	66.1	102,508	2,500	3.2	62	3,147,678	50,769
New Mexico	12	18.5	337,198	28,100	11.6	34	52.3	46,613	1,371	1.6	65	2,915,173	44,849
North Carolina	2	100.0	36,019	18,010	100.0						2	36,019	18,010
North Dakota	25	17.4	572,146	22,886	41.4	114	79.2	263,741	2,314	19.0	144	1,385,400	9,621
Ohio	223	18.1	5,184,100	23,247	12.8	792	64.2	1,660,126	2,096	4.1	1,233	40,546,443	32,884
Oklahoma	55	33.8	1,241,487	22,572	43.0	95	58.4	227,976	2,400	8.0	163	2,885,038	17,699
Pennsylvania	872	24.0	20,824,245	23,881	12.1	1,997	54.9	4,827,211	2,417	2.8	3,637	171,879,913	47,259
South Dakota						15	100.0	10,379	692	100.0	15	10,379	692
Tennessee	68	29.3	1,711,550	25,170	28.3	126	54.3	361,909	2,872	6.0	232	6,040,268	26,036
Texas	27	61.4	672,949	24,924	56.7	8	18.1	48,917	6,115	4.1	44	1,187,329	26,985
Utah	2	5.2	45,938	22,969	1.0	12	31.6	32,709	2,726	.7	38	4,720,217	124,216
Virginia	50	25.6	1,273,741	25,475	10.8	94	48.3	225,623	2,400	1.9	195	11,761,643	60,316
Washington	13	22.8	313,416	24,878	10.7	28	49.1	76,557	2,734	2.6	57	2,926,392	51,340
West Virginia	589	32.8	15,587,203	26,464	14.4	546	30.3	1,855,253	3,398	1.7	1,798	107,899,941	60,011
Wyoming	3	4.5	105,283	21,057	1.4	18	26.9	38,188	2,122	.5	67	7,575,031	113,060
	2,742	23.4	68,769,361	25,080	12.2	6,114	52.2	14,779,838	2,417	2.6	11,715	564,564,662	48,192

Responses from all the coal-originating railroads enabled the Geological Survey to identify 2,384 wagon mines that shipped coal in railroad cars in 1923. The total production of these mines was 1,141,431 tons, and the value of this output is estimated from the spot prices prevailing during the year at $3,644,000. By States, the figures are given in the following table. As in 1922, Pennsylvania, Ohio, and Kentucky led in number of the small operations. The total number was less than half of that in 1922.[18]

No attempt was made to ascertain the output of country coal banks having no access to a railroad, because it had been found from previous efforts that although the number of such banks runs into the thousands, they contribute less than a million tons to the yearly supply of coal.

TABLE 50.—*Number and production of wagon mines shipping bituminous coal by rail in 1923*

State	Number	Production (net tons)	Estimated value	State	Number	Production (net tons)	Estimated value
Alabama	27	38, 010	$85, 000	North Dakota	22	28, 446	$64, 000
Arkansas	52	63, 650	207, 000	Ohio	327	91, 668	272, 000
Colorado	17	19, 220	56, 000	Oklahoma	48	44, 688	145, 000
Illinois	50	58, 021	180, 000	Pennsylvania	769	238, 957	848, 000
Indiana	103	91, 204	283, 000	Tennessee	41	11, 100	33, 000
Iowa	14	8, 750	26, 000	Utah	1	400	1, 000
Kansas	168	115, 161	375, 000	Virginia	27	9, 533	31, 000
Kentucky	421	106, 485	321, 000	Washington	1	150	500
Maryland	41	22, 649	83, 000	West Virginia	132	68, 493	260, 000
Michigan	1	150	500	Wyoming	5	15, 687	44, 000
Missouri	80	88, 939	267, 000				
Montana	14	3, 331	10, 000		2, 384	1, 141, 431	3, 644, 000
New Mexico	23	16, 739	52, 000				

LOCATION OF SMALL MINES

The location of the small mines from which the Geological Survey has succeeded in obtaining reports is shown by counties in Table 51. The table is based upon the returns for 1918 and 1920, years of high prices and maximum activity among the small producers. The study would not be worth repeating each year, but because of the lack of information that has hitherto prevented intelligent discussion of the subject, it is deemed worth while to show for a typical period the enormous numbers of small operations concentrated in certain of the coal fields. The burden laid upon the railroads by the necessity of furnishing transportation at so many scattered points of origin was a factor in the transportation disability of 1917–1920 and 1922, the importance of which has not been fully realized.

The table is far from complete, because it shows only those operations from which the Survey obtained reports. There were undoubtedly a great many others. The mines reporting in 1918 and 1920 were grouped by counties, and the figure used is the larger of those for the two years. The result is believed to be as nearly a complete count of the number of the small operations as will ever be made for the country as a whole.

The table reveals the concentration of the little mines in the hilly country of the Appalachians, where coal beds crop out along almost every railroad. In the Mississippi Valley, on the other hand, the sites available for wagon-mine operation are few, and aside from southern Indiana and scattering counties in Kansas and Illinois the number of such operations recorded by the Survey is small.

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[18] See U. S. Geol. Survey Mineral Resources, 1922, pt. 2, p. 535, 1924.

It is, therefore, in Pennsylvania, Ohio, Kentucky, and northern West Virginia that the effect of wagon mines in diluting the supply of cars and labor for the large commercial operations is most serious. The Pennsylvania, Baltimore & Ohio, Chesapeake & Ohio, and Louisville & Nashville railroads together were called upon to serve 2,895 wagon mines in 1922. The New York Central Railroad is exempted by a provision of its charter from the duty of supplying cars for such small operations.

LOCATION OF COMMERCIAL MINES

Table 51 also gives the number of commercial mines in operation in each county in 1923. The data are arranged by size classes. The table constitutes the first attempt to show for the country as a whole the location of the commercial operations by counties.

It is not always possible to determine whether a given operation in which coal reaches the surface through more than one opening should be called one mine or several mines. The typical shaft mine of the prairies of Illinois presents no difficulty of classification, but in hilly country, where the seams are reached by drifts or slopes, opinions will differ as to whether separate openings discharging coal over a common tipple are to be classed as one mine or as several. The Geological Survey has followed the judgment of the operator reporting as to what constitutes a mine, but sufficient variety of opinion is noted in the reports to suggest that the statistics would be improved by the adoption of a standard definition of a mine. Moreover, the point has an interest beyond the tabulation of statistics, in the determination of which mine holds the record for production. If the two openings of the Lynch operations of the United States Coal & Coke Co. are regarded as a single mine, it easily holds the record over certain shaft mines in Illinois that have produced more than either of the Lynch openings separately. Discussion is invited as to the tests that should be adopted in determining what constitutes one mine.

As might be expected, the region of greatest density in simple number of commercial operations is Pennsylvania. In this State it is becoming increasingly difficult to find a site for a new operation of large size. Other regions where the commercial mines are relatively close together are northern West Virginia, Ohio, and the valleys of the middle Appalachians. In sharp contrast to the coal fields of the East, those of the far West have been attacked from relatively few openings.

Even in the interior fields it is easy to distinguish in the table the regions of broken topography, where outcrops accessible to slope and drift are common, from the flat-lying country, where the coal must be reached through a shaft.

TABLE 51.—*Number of soft-coal mines of which the Geological Survey has record, by counties*

[The figures for small mines include wagon mines shipping by rail and country banks of which the Survey has record as producing in 1918 or in 1920. The figure given for each county is the maximum for the two years. The figure for commercial or local commercial mines represents all mines reporting in 1923, including those temporarily idle but not permanently abandoned]

County	Small mines	Commercial and local commercial					
		Class 1	Class 2	Class 3	Class 4	Class 5	Total
ALABAMA							
Bibb			3	7	12	4	26
Blount			2		2		4
Etowah	1				3	2	5
Franklin						1	1
Jefferson	5	16	11	17	30	16	90
Lawrence	1						
Marion			1		1		2
St. Clair			6	1		3	10
Shelby	1			5	11	3	19
Tuscaloosa		2	3	2	5	5	17
Walker	61	6	12	17	44	26	105
Winston	3					9	9
	72	24	38	49	108	69	288
ARKANSAS							
Franklin	7				8	7	15
Johnson	3				6	14	20
Logan	4				3	11	14
Pope				1		1	2
Scott	1					2	2
Sebastian	17		1	3	12	24	40
Washington	1					1	1
	33		1	4	29	60	94
CALIFORNIA							
Amador						1	1
Riverside						1	1
						2	2
COLORADO							
Archuleta						1	1
Boulder			3	1	8	7	19
Delta	7			1		11	12
Denver	1						
Elbert						2	2
El Paso		1		1	2	7	11
Fremont	2		1	5	4	11	21
Garfield					1	6	7
Gunnison		1		2	5	2	10
Huerfano	2	3	4	4	10	11	32
Jackson				1		2	3
Jefferson			1			1	2
La Plata	1			1	2	7	10
Las Animas	3	7	5	6	7	21	46
Mesa	4			1	3	13	17
Moffatt	8					1	1
Montezuma	4					2	2
Montrose	5					1	1
Pitkin						2	2
Rio Blanco	1					3	3
Routt	4	1	2	3	4	9	19
Weld	1	2	3	5	3	2	15
	43	15	19	31	49	122	236
GEORGIA							
Walker				1		2	3
IDAHO							
Teton						1	1

TABLE 51.—*Number of soft-coal mines of which the Geological Survey has record, by counties*—Continued

County	Small mines	Commercial and local commercial					
		Class 1	Class 2	Class 3	Class 4	Class 5	Total
ILLINOIS							
Bond		1					1
Brown	8						
Bureau		1	2	1		5	9
Cass	1					2	2
Christian		7	1		2	1	11
Clinton	1	1	3		1		5
Edgar						1	1
Franklin		22	2	3			27
Fulton	44	4	4	6	7	27	48
Gallatin	6				1	2	3
Greene	4					2	2
Grundy			1		1	3	5
Hancock						1	1
Henry	1				1	12	13
Jackson	6	1	2	3	3	10	19
Jefferson	6					1	1
Jersey	2						
Johnson	3					1	1
Knox	18					8	8
La Salle	3		2	3	3	12	20
Livingston	1				3	4	7
Logan		1		1			2
McDonough	11					3	3
McLean					1		1
Macon			1	1		1	3
Macoupin	6	12	1	1	3	2	19
Madison	1	6	5	2	3	5	21
Marion		1	2				3
Marshall	4	1		1		5	7
Menard					3	7	10
Mercer	4		1			5	6
Montgomery		6	1	1		1	9
Morgan	1						
Moultrie			1				1
Peoria	13	2	1	3	8	11	25
Perry	1	3	7	5	5	2	22
Putnam		1		1			2
Randolph		3	2	3	1	6	15
Rock Island					1	3	4
St. Clair	1	5	16	10	20	10	61
Saline	10	11	6	2	4	6	29
Sangamon	1	17	4	3	3	4	31
Schuyler	19					2	2
Scott	3						
Shelby					1	4	5
Stark	2					4	4
Tazewell		1	1	1	4	3	10
Vermilion	11	8	5	3	5	10	31
Warren	2					1	1
Washington		1	1		1	2	5
White				1			1
Will						1	1
Williamson	9	18	10	8	12	7	55
Woodford				1	1		2
	203	134	82	64	98	197	575
INDIANA							
Clay	42		2	3	5	19	29
Daviess	4			2	2	7	11
Dubois	6					1	1
Fountain	4					1	1
Gibson	6		3	1	4	2	10
Greene	36	4	3	5	9	15	36
Knox	10	7	2	1	4	6	20
Martin	17						
Orange	2						
Owen	13			1	1	4	6
Parke	5			1	1	8	10
Perry	11					2	2
Pike	32	4	1	4	4	7	20
Spencer	9					4	4
Sullivan	11	11	7	8	14	9	49
Vanderburg	1		1	1	1		3
Vermilion	6	5	6	7	4	1	23
Vigo	19	16	7	9	14	10	56
Warren	1					1	1
Warrick	13	1	2	2	9	5	19
	248	48	34	45	72	102	301

TABLE 51.—*Number of soft-coal mines of which the Geological Survey has record, by counties*—Continued

County	Small mines	Commercial and local commercial					
		Class 1	Class 2	Class 3	Class 4	Class 5	Total
IOWA							
Adams	1						
Appanoose	12			3	27	24	54
Boone			1		3	2	6
Dallas			2	4			6
Davis	3						
Guthrie						1	1
Jasper	1			1		2	3
Jefferson	1					1	1
Keokuk						1	1
Lucas	3	1	2		1		4
Mahaska	6				1	7	8
Marion	3	1	1	2	3	9	16
Monroe	1	2	4	4	4		14
Page					1	1	2
Polk	2		1	5	7	4	17
Taylor					1		1
Van Buren	4					2	2
Wapello	6				1	9	10
Warren	4				1	2	3
Wayne	4				1	1	2
Webster	2						
	53	4	11	19	51	66	151
KANSAS							
Bourbon	15						
Cherokee	64		1	3	8	61	73
Crawford	17		7	19	24	69	119
Franklin	7						
Labette	1						
Leavenworth				1	1	1	3
Linn	4				2	7	9
Osage	12					18	18
	120		8	23	35	156	222
KENTUCKY							
Butler	4						
Bell	25	1	3	15	26	41	86
Boyd	16			1	3	4	8
Breathitt	25			1	4	19	24
Carter	12				5	7	12
Christian						2	2
Clay	18				6	8	14
Clinton	1						
Crittenden	2				1		1
Daviess	5				5	3	8
Edmonson	3						
Elliott	9						
Floyd	16	1	5	11	49	27	93
Greenup	8						
Hancock	3					1	1
Harlan	15	7	22	12	27	6	74
Henderson	2		1	1	5	5	12
Hopkins	10	2	8	8	13	15	46
Jackson	5						
Johnson	10		1	5	4	6	16
Knott	19	1		2			3
Knox	21		1	1	8	13	23
Laurel	26				4	9	13
Lawrence	18					4	4
Lee	2				1	7	8
Leslie	14						
Letcher	23	1	18	14	17	10	60
McCracken	1						
McCreary	4	1	3	2	3	6	15
McLean	2				3	3	6
Madison	1						
Magoffin	15						
Martin	12	1		1	2	1	5
Morgan	11				1	5	6
Muhlenberg	11	5	14	8	4	3	34
Ohio	5	1	3	4	2	12	22
Owsley	8					1	1
Perry	14	4	14	17	19	17	71

TABLE 51.—*Number of soft-coal mines of which the Geological Survey has record, by counties*—Continued

County	Small mines	Commercial and local commercial					
		Class 1	Class 2	Class 3	Class 4	Class 5	Total
KENTUCKY—continued							
Pike	30	7	11	21	35	17	91
Pulaski	3						
Rockcastle	4						
Union	5	2	4	1	2	5	14
Wayne	1					1	1
Webster	15	2	1	6	8	9	26
Whitley	22		1	1	10	23	35
Wolfe	9						
	485	36	110	132	267	290	835
MARYLAND							
Allegany	78		1	8	26	32	67
Garrett	22		2	4	6	26	38
	100		3	12	32	58	105
MICHIGAN							
Bay			3		1		4
Calhoun					1		1
Clinton	2						
Eaton	5						
Saginaw		2		2	3		7
Shiawassee						1	1
Tuscola							
	7	2	3	2	5	1	13
MISSOURI							
Adair	4		1		3	4	8
Audrain	2					3	3
Barton	19			7	10	2	19
Bates	19				5	7	12
Boone	13					2	2
Caldwell						1	1
Callaway	4				1	3	4
Carroll	3						
Cass						1	1
Cedar	4						
Chariton	10					1	1
Clay					1		1
Cooper	1						
Dade	3					1	1
Franklin	1						
Grundy						1	1
Harrison						1	1
Henry	29			1	1	5	7
Howard	2						
Jasper	1						
Johnson	8			1		2	3
Lafayette	6		2	2	2	17	23
Lincoln						1	1
Linn					1	4	5
Macon	12	1	1	1	3	2	8
Moniteau	1						
Monroe	1						
Montgomery	1						
Platte				1			1
Putnam	12					4	4
Ralls	8					1	1
Randolph	19			3	2	2	7
Ray	10			2	13	13	28
Saline	1						
St. Clair	9					1	1
Schuyler						1	1
Sullivan	1						
Vernon	16					4	4
	220	1	4	18	42	84	149

TABLE 51.—*Number of soft-coal mines of which the Geological Survey has record, by counties*—Continued

County	Small mines	Commercial and local commercial					
		Class 1	Class 2	Class 3	Class 4	Class 5	Total
MONTANA							
Blaine	5					4	4
Carbon		1	3		2		6
Cascade	1	1		4	4	8	17
Chouteau						1	1
Dawson	1						
Fergus	8						
Gallatin						1	1
Hill	8					3	3
Judith Basin	2						
Musselshell	1	2		1	2	3	8
Pondera						1	1
Richland					1		1
Roosevelt	1					1	1
Rosebud	1						
Sheridan	12					4	4
Toole						1	1
Valley	6						
Yellowstone	1						
	47	4	3	5	9	27	48
NEW MEXICO							
Colfax		1	12		1	3	17
Lincoln						1	1
McKinley	1	1	2	1	4	3	11
Rio Arriba					2	1	3
San Juan	3					3	3
Santa Fe				1	4		5
Socorro				1	1		2
	4	2	14	3	12	11	42
NORTH CAROLINA							
Chatham					1		1
Lee					1		1
					2		2
NORTH DAKOTA							
Adams	3				2	5	7
Billings					2		2
Bowman					1	1	2
Burke	2		1		4	5	10
Burleigh	4	1				6	7
Divide	2				2	3	5
Dunn	12				1	2	3
Grant	4					6	6
Hettinger	17					8	8
McLean	10				4	13	17
Mercer	1			3		3	6
Morton	22				2	6	8
Mountrail						3	3
Oliver	10					1	1
Stark	31				3	2	5
Ward	2				1	17	18
Williams	5				3	11	14
	125	1	1	3	25	92	122
OHIO							
Athens	17	6	11	8	28	46	99
Belmont	163	24	24	16	19	24	107
Carroll	18	1			10	8	19
Columbiana	35	1	2	4	6	12	25
Coshocton	43				9	17	26
Gallia	41						
Guernsey	55	6	9	3	12	7	37
Harrison	36	3	7	9	7	10	36
Hocking	6	1	1	2	20	44	68
Holmes	11					3	3
Jackson	65				4	46	50
Jefferson	18	14	13	8	19	20	74
Lawrence	29			1	1	17	19
Mahoning	6				1	11	12
Medina					1	2	3

TABLE 51.—*Number of soft-coal mines of which the Geological Survey has record, by counties*—Continued

County	Small mines	Commercial and local commercial					
		Class 1	Class 2	Class 3	Class 4	Class 5	Total
OHIO—continued							
Meigs	11	---------	5	5	10	14	34
Morgan	1	---------	1	1	---------	---------	2
Muskingum	88	---------	1	2	6	33	42
Noble	47	2	1	1	1	2	7
Perry	86	---------	8	8	25	52	93
Portage	---------	---------	---------	1	1	1	3
Scioto	13	---------	---------	---------	---------	1	1
Stark	29	---------	1	---------	11	23	35
Summit	1	---------	---------	---------	---------	2	2
Trumbull	1	---------	---------	---------	---------	---------	---------
Tuscarawas	99	---------	---------	7	28	57	92
Vinton	23	---------	---------	---------	3	11	14
Washington	8	---------	---------	---------	---------	1	1
Wayne	1	---------	---------	---------	1	1	2
	951	58	84	76	223	465	906
OKLAHOMA							
Coal	---------	---------	---------	---------	1	6	7
Craig	13	---------	---------	---------	---------	1	1
Haskell	---------	---------	---------	---------	8	1	9
Latimer	1	---------	---------	---------	5	5	10
Le Flore	2	---------	---------	2	3	8	13
Muskogee	2	---------	---------	---------	1	---------	1
Nowata	1	---------	---------	---------	---------	---------	---------
Okmulgee	2	---------	1	3	14	9	27
Pittsburg	2	1	2	3	17	12	35
Rogers	5	---------	---------	---------	1	1	2
Tulsa	6	---------	---------	1	4	4	9
Wagoner	---------	---------	---------	---------	1	---------	1
	34	1	3	9	55	47	115
OREGON							
Coos	1	---------	---------	---------	1	1	2
PENNSYLVANIA							
Allegheny	185	39	16	12	80	158	305
Armstrong	146	3	7	18	64	55	147
Beaver	9	---------	---------	1	7	12	20
Bedford	3	---------	1	3	14	16	34
Blair	1	---------	---------	1	2	7	10
Bradford	---------	---------	---------	---------	---------	4	4
Butler	36	---------	3	6	34	37	80
Cambria	244	26	29	55	118	103	331
Cameron	3	---------	---------	---------	---------	1	1
Center	73	---------	1	7	22	31	61
Clarion	187	---------	3	7	28	39	77
Clearfield	200	5	12	11	123	207	358
Clinton	1	---------	1	---------	3	5	9
Elk	17	---------	3	5	10	38	56
Fayette	365	65	26	22	65	102	280
Fulton	---------	---------	---------	1	---------	---------	1
Greene	16	6	4	5	6	10	31
Huntingdon	1	---------	2	4	7	15	28
Indiana	151	2	36	37	66	49	190
Jefferson	241	3	7	17	36	66	129
Lawrence	5	---------	1	1	1	3	6
Lycoming	---------	---------	---------	---------	---------	1	1
McKean	---------	---------	---------	---------	---------	1	1
Mercer	26	---------	2	2	4	5	13
Somerset	360	5	15	31	97	104	252
Tioga	3	---------	2	2	2	9	15
Washington	137	39	32	12	22	35	140
Westmoreland	351	54	31	27	61	115	288
	2,761	247	234	287	872	1,228	2,868

TABLE 51.—*Number of soft-coal mines of which the Geological Survey has record, by counties*—Continued

County	Small mines	Commercial and local commercial					
		Class 1	Class 2	Class 3	Class 4	Class 5	Total
SOUTH DAKOTA							
Dewey						1	1
Harding						2	2
Meade						2	2
Perkins						9	9
Ziebach						1	1
						15	15
TENNESSEE							
Anderson			1	3	9	9	22
Bledsoe	1			1			1
Campbell	11	1		6	17	15	39
Claiborne	1	1	4	3	4	2	14
Cumberland	1					4	4
Fentress	2			5	1	2	8
Franklin	3						
Grundy	2	1		1	9	6	17
Hamilton	2			3	5	2	10
Marion				2	2	2	6
Morgan	37				12	17	29
Overton			1		1	3	5
Rhea	2				1	3	4
Roane	9		1			5	6
Sequatchie			1		1		2
Scott	13				5	14	19
White	2		3		1	1	5
	86	3	11	24	68	85	191
TEXAS							
Anderson						1	1
Bastrop				1	7		8
Bexar					1		1
Erath					1		1
Henderson				3	2		5
Hopkins					2		2
Houston					2		2
Lee					1		1
Leon				2			2
Maverick						3	3
Milam					4		4
Nacogdoches					3	1	4
Palo Pinto					2	1	3
Shelby					1		1
Titus				1		1	2
Webb				1			1
Wise					1	1	2
Wood				1			1
				9	27	8	44
UTAH							
Carbon		9	8	5		2	24
Emery	1	1				3	4
Grand				1			1
Iron	2					1	1
San Juan						1	1
San Pete	1						
Summit					2	2	4
Uintah	4					2	2
	8	10	8	6	2	11	37
VIRGINIA							
Buchanan	3						
Chesterfield						1	1
Dickenson	3		4	2	2	5	13
Lee	13	1	1	7	10	19	38
Montgomery	1			1		4	5
Pulaski				1	1		2
Russell	7	6	1	1	8	12	28
Scott					1		1
Tazewell	21	2	1	2	12	2	19
Wise	46	10	5	6	16	24	61
	94	19	12	20	50	67	168

TABLE 51.—*Number of soft-coal mines of which the Geological Survey has record, by counties*—Continued

County	Small mines	Commercial and local commercial					
		Class 1	Class 2	Class 3	Class 4	Class 5	Total
WASHINGTON							
Cowlitz						1	1
King	1	2			7	7	16
Kittitas	1	1	5	3	1	2	12
Lewis					3	15	18
Pierce			2	1	1		4
Thurston		1			1	1	3
Whatcom			1			1	2
	2	4	8	4	13	27	56
WEST VIRGINIA							
Barbour	39	5	4	9	9	24	51
Boone	3		2	15	36	15	68
Braxton	47			2	8	7	17
Brooke	7	4	3	2	7	5	21
Cabell	3						
Clay	3	1		1	12	10	24
Fayette	1	6	28	39	52	15	140
Gilmer	10			2		1	3
Grant	1			1	1		2
Greenbrier	2		2	5	3	3	13
Hancock	1					3	3
Harrison	30	4	17	29	53	38	141
Kanawha	48	3	8	26	66	62	165
Lewis	36				4	8	12
Lincoln	14		1	1	4	11	17
Logan	1	18	26	43	66	11	164
McDowell	18	23	40	33	47	18	161
Marion	16	16	7	4	20	16	63
Marshall		4	3	1	3	1	12
Mason	3			1	2	4	7
Mercer	9	4	13	6	3	4	30
Mineral	2				15	19	34
Mingo	30		15	13	30	11	69
Monongalia	17	14	12	21	33	25	105
Nicholas	2			1	8	9	18
Ohio		4	2	3	6		15
Preston	142	2	4	5	26	27	64
Putnam	6		1		8	1	10
Raleigh	4	10	23	30	30	8	101
Randolph	6	1		2	6	6	15
Summers			1			3	4
Taylor	34	1	1	2	10	11	25
Tucker			4	3	5		12
Upshur	65		3	4	8	22	37
Wayne	60		1	1	1	6	9
Webster	21				1	6	7
Wetzel	4						
Wyoming	2	2	2	13	6	4	27
	687	122	223	318	589	414	1,666
WYOMING							
Albany						1	1
Big Horn	1						
Campbell	2						
Carbon		2		1		1	4
Converse						1	1
Crook	1						
Fremont			1				1
Hot Springs	3	1	1				2
Johnson	2					2	2
Lincoln	3	1	8	1			10
Natrona	1						
Park	5					1	1
Sheridan	7	2	1		1	4	8
Sweetwater		7	9	10	1	3	30
Uinta	1				1		1
Weston			1				1
	26	13	21	12	3	13	62

CHANGE IN NUMBER OF COMMERCIAL MINES, 1905-1923

By excluding the wagon mines and limiting the comparison to the commercial operations, it is possible to trace the growth of the number of mines over a period of 19 years. In 1905 the number of operations in the commercial class recorded by the Geological Survey was 5,060. Up to the outbreak of the World War the increase in the total number of mines was not large. In 1913 the commercial operations had risen to 5,776. This was indeed 14 per cent more mines than 1905, but in the same period the output of coal had increased by 52 per cent. Furthermore, the growth in number of mines in this nine-year period had occurred chiefly among the larger size classes. The number of mines in class 1 had increased by 69 per cent, and the number in class 2 by 37 per cent, while in class 5, the smallest of the commercial operations, the increase had been only 0.8 per cent.

From 1913 to 1923 the nature of the growth in number of mines was quite the reverse. These 10 years were marked by relatively small increases in the number of class 1 and class 2 mines and a very large increase in class 5 mines. The growth in number of class 1 mines (mines producing over 200,000 tons in the years in question) was at the rate of only 8 per cent, and in class 2 mines (from 100,000 to 200,000 tons), it was 12 per cent. The number of class 5 mines, on the other hand, more than doubled, rising from 1,728 in 1913 to 3,730 in 1923.

In this classification, it should be remembered, the mines are grouped not according to capacity but according to production in the particular year of the classification, and the showing is therefore influenced by the state of the market. To compare the number of class 1 mines in the depressed year 1921 or the strike year 1922 with that in the normal year 1913 would lead to false conclusions. The year 1923, however, was one of large output and may properly be matched against 1913.

When the comparison is shifted from the number in each class to the tonnage in each class, the change from 1913 to 1923 is less apparent, yet even here we find that the tonnage of class 5 mines doubled, whereas the tonnage produced by all classes increased only 18 per cent.

This great increase in the relative number of small mines has unquestionably been a factor in the difficult position of the industry since the war, not because the smaller mines have greatly inflated capacity, for in 1923 the class 5 group contributed only 2.4 per cent of the total output, not including the wagon mines, but rather because these small commercial operations, like the wagon mines, threw upon the carriers the burden of providing transportation at a much larger number of shipping points. The multiplication of the class 5 mines alone, shown in Table 52, compelled the railroads to furnish cars at some 1,909 more sidings and tipples than they were accustomed to serve before the war, and the resulting dilution of transportation capacity and undue detention of cars during the act of loading were more serious obstacles than is generally realized in meeting the demand for coal cars.

To prevent possible misunderstanding, attention is again called to the fact that Table 52 and this discussion accompanying it refer to the commercial mines only.

TABLE 52.—*Number and yearly output of commercial bituminous-coal mines, by size classes, 1905–1923* [a]

[Exclusive of wagon mines]

Year	Class 1 (more than 200,000 tons)	Class 2 (100,000 to 200,000 tons)	Class 3 (50,000 to 100,000 tons)	Class 4 (10,000 to 50,000 tons)	Class 5 (less than 10,000 tons)	Total
Number of mines:						
1905	411	612	808	1,514	1,715	5,060
1910	618	763	960	1,568	1,909	5,818
1913	694	837	959	1,558	1,728	5,776
1917	792	914	1,044	1,996	2,193	6,939
1918	821	929	1,198	2,636	2,735	8,319
1919	550	854	1,181	2,784	3,625	8,994
1920	701	1,031	1,279	3,160	2,750	8,921
1921	482	807	1,003	2,346	3,400	8,038
1922	416	848	1,084	3,139	3,812	9,299
1923	748	935	1,176	2,742	3,730	9,331
Net tons produced:						
1905	126,499,000	85,920,000	57,386,000	38,995,000	6,034,000	314,834,000
1910	191,519,000	107,052,000	68,858,000	42,282,000	6,561,000	416,272,000
1913	241,463,000	118,476,000	69,018,000	42,292,000	6,280,000	477,529,000
1917	285,366,000	129,486,000	74,894,000	51,596,000	8,824,000	550,166,000
1918	281,267,000	131,027,000	87,143,000	67,453,000	11,387,000	578,277,000
1919	174,848,000	120,926,000	84,625,000	71,334,000	13,198,000	464,931,000
1920	237,468,000	142,750,000	90,669,000	82,129,000	10,716,000	563,732,000
1921	162,438,000	115,607,000	71,160,000	56,099,000	10,618,000	415,922,000
1922	131,876,000	117,195,000	77,287,000	77,203,000	15,248,000	418,809,000
1923	265,869,000	130,804,000	84,342,000	68,769,000	13,639,000	563,423,000
Percentage of total number of mines:						
1905	8.1	12.1	16.0	29.9	33.9	100.0
1910	10.6	13.1	16.5	27.0	32.8	100.0
1913	12.0	14.5	16.6	27.0	29.9	100.0
1917	11.4	13.2	15.0	28.8	31.6	100.0
1918	9.8	11.2	14.4	31.7	32.9	100.0
1919	6.1	9.5	13.1	31.0	40.3	100.0
1920	7.9	11.6	14.3	35.4	30.8	100.0
1921	6.0	10.0	12.5	29.2	42.3	100.0
1922	4.5	9.1	11.7	33.7	41.0	100.0
1923	8.0	10.0	12.6	29.4	40.0	100.0
Percentage of total tonnage:						
1905	40.2	27.3	18.2	12.4	1.9	100.0
1910	46.0	25.7	16.5	10.2	1.6	100.0
1913	50.6	24.8	14.4	8.9	1.3	100.0
1917	51.9	23.5	13.6	9.4	1.6	100.0
1918	48.6	22.7	15.1	11.6	2.0	100.0
1919	37.6	26.0	18.2	15.4	2.8	100.0
1920	42.1	25.3	16.1	14.6	1.9	100.0
1921	39.1	27.8	17.1	13.5	2.5	100.0
1922	31.5	28.0	18.5	18.4	3.6	100.0
1923	47.2	23.2	15.0	12.2	2.4	100.0

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[a] This table shows mines, not companies, and should not be confused with other tables that include country banks and many wagon mines shipping by rail.

RELATIVE NUMBER OF IDLE, PART-TIME, AND FULL-TIME MINES

Not only does the number of mines in operation vary from year to year, but within the limits of a single year varying conditions of the market may be reflected in changes in the number of active mines. A significant index of this variation is afforded by Table 53, which shows the proportion of idle, part-time, and full-time mines in the group that reported their weekly running time to the Geological Survey in the three years 1921–1923. These mines, numbering about 2,500, are of course only a small part of the total number of mines, but they produce more than half the total output. They include no wagon mines. They are commercial operations of some size, each affiliated with an operators' association or large enough to maintain a permanent office force and to send in a report weekly to the Survey. They may be taken as fairly representative of the commercial mines exclusive of the consumer-owned tonnage.

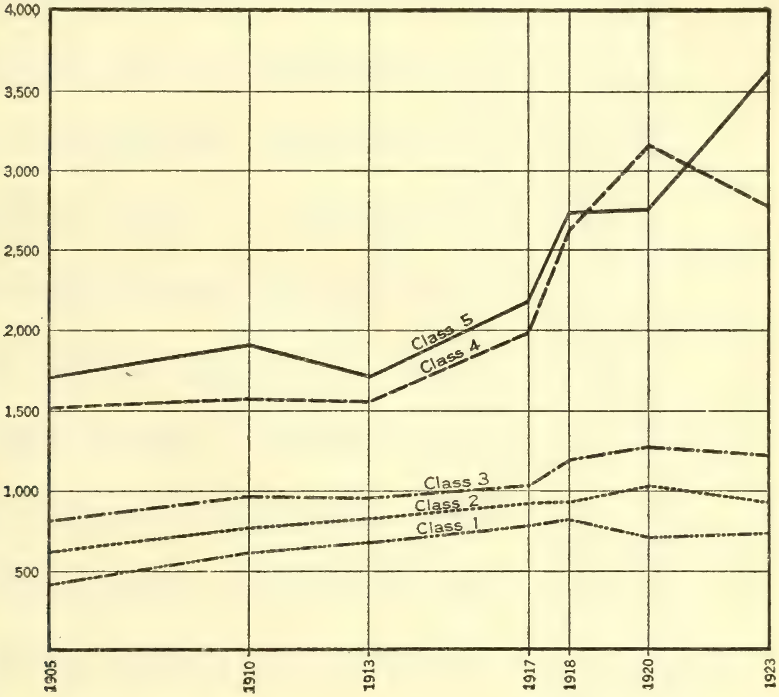

FIGURE 43.—Number of commercial mines in each size class, 1905–1923. Note that wagon mines are not included

Table 53 is based on a special recompilation of the Geological Survey's records by the Bureau of Labor Statistics. The data are shown graphically in Figure 29.

TABLE 53.—*Number and percentage of mines reporting weekly to the Geological Survey that were closed and number working part time and full time, August, 1920, to December, 1923*

Week ended—	Total number reporting	Mines shut down entire week		Mines working													
				1 and less than 8 hours		8 and less than 16 hours		16 and less than 24 hours		24 and less than 32 hours		32 and less than 40 hours		40 and less than 48 hours		Full time of 48 hours or more	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
1920																	
Aug. 21	2,840	96	3.4	67	2.4	261	9.2	500	17.6	590	20.7	513	18.0	476	16.8	337	11.9
1921																	
Aug. 20	2,697	970	35.9	69	2.6	280	10.4	407	15.1	327	12.1	263	9.7	201	7.5	180	6.7
Oct. 8	2,557	953	37.3	47	1.8	176	6.9	299	11.7	357	14.0	264	10.3	267	10.4	194	7.6
Oct. 15	2,552	895	35.1	35	1.4	179	7.0	274	10.7	348	13.6	315	12.4	286	11.2	220	8.6
Oct. 22	2,584	867	33.6	28	1.1	140	5.4	225	8.7	294	11.4	382	14.7	372	14.4	276	10.7
Oct. 29	2,579	846	32.8	38	1.5	150	5.8	291	11.3	372	14.4	389	15.1	282	10.9	211	8.2
Nov. 5	2,565	896	34.9	58	2.3	234	9.1	318	12.4	361	14.1	293	11.4	234	9.1	171	6.7
Nov. 12	2,578	914	35.5	70	2.7	261	10.1	340	13.2	363	14.1	314	12.1	249	9.7	[a] 67	[a] 2.6
Nov. 19	2,538	920	36.2	72	2.8	264	10.4	324	12.8	299	11.8	240	9.5	228	9.0	191	7.5
Nov. 26	2,575	1,059	41.1	102	4.0	306	11.9	381	14.8	287	11.1	200	7.8	199	7.7	[a] 41	[a] 1.6
Dec. 3	2,273	1,027	45.2	89	3.9	295	13.0	274	12.0	226	9.9	143	6.3	122	5.4	97	4.3
Dec. 10	2,511	1,119	44.6	89	3.5	277	11.0	347	13.8	270	10.8	167	6.7	139	5.5	103	4.1
Dec. 17	2,465	1,099	44.6	85	3.4	290	11.8	327	13.3	275	11.2	188	7.6	109	4.4	92	3.7
Dec. 24	2,500	1,102	44.1	68	2.7	266	10.6	317	12.7	292	11.7	225	9.0	156	6.2	74	3.0
Dec. 31	2,379	1,198	50.4	86	3.6	275	11.6	274	11.5	236	9.9	178	7.5	113	4.7	[a] 19	[a] .8
1922																	
Jan. 7	2,408	1,055	43.8	63	2.6	220	9.2	304	12.6	285	11.8	238	9.9	175	7.3	[a] 68	[a] 2.8
Jan. 14	2,323	933	40.2	50	2.2	176	7.6	301	13.0	324	13.9	231	9.9	186	8.0	122	5.2
Jan. 21	2,316	903	39.0	48	2.1	167	7.2	267	11.5	305	13.2	246	10.6	195	8.4	185	8.0
Jan. 28	2,260	865	38.3	47	2.1	144	6.4	240	10.6	291	12.8	267	11.8	219	9.7	187	8.3
Feb. 4	2,086	787	37.7	37	1.8	134	6.4	236	11.3	276	13.2	202	9.7	232	11.2	182	8.7
Feb. 11	2,351	880	37.5	48	2.0	132	5.6	253	10.8	287	12.2	245	10.4	266	11.3	240	10.2
Oct. 7	2,216	96	4.3	233	10.5	691	31.2	458	20.7	317	14.3	171	7.7	122	5.5	128	5.8
Oct. 14	2,143	66	3.1	198	9.2	640	29.9	574	26.8	265	12.4	159	7.4	107	5.0	134	6.2
Oct. 21	2,249	97	4.3	200	8.9	722	32.1	526	23.4	275	12.2	158	7.0	136	6.1	135	6.0
Oct. 28	2,113	88	4.2	185	8.8	550	26.0	529	25.0	289	13.7	195	9.2	145	6.9	132	6.2
Nov. 4	2,318	97	4.2	170	7.3	652	28.1	574	24.8	361	15.6	206	8.9	119	5.1	139	6.0
Nov. 11	2,340	95	4.2	147	6.3	752	32.1	630	26.9	324	13.8	197	8.4	129	5.5	[a] 66	[a] 2.8
Nov. 18	2,312	76	3.3	181	7.8	646	28.0	568	24.6	306	13.2	202	8.7	174	7.5	159	6.9
Nov. 25	2,210	94	4.3	197	8.9	620	28.1	562	25.4	286	12.9	187	8.5	137	6.2	127	5.7
Dec. 2	2,190	96	4.4	233	10.6	623	28.4	526	24.0	282	12.9	199	9.1	183	8.4	[a] 48	[a] 2.2

Dec. 9	2,178	131	6.0	204	9.4	602	27.6	426	19.5	304	14.0	167	7.7	180	8.3	164	7.5
Dec. 16	2,091	92	4.4	245	11.7	606	29.0	480	23.0	238	11.4	170	8.1	180	8.6	[b] 80	[b] 3.8
Dec. 23	2,104	81	3.8	236	11.2	706	33.6	427	20.3	213	10.1	168	8.0	156	7.4	117	5.6
Dec. 30	2,228	106	4.7	195	8.7	652	29.3	561	25.2	302	13.5	224	10.1	180	8.1	[a] 8	[a] .4
1923																	
Jan. 6	2,442	128	5.2	205	8.4	657	26.9	598	24.5	343	14.0	253	10.4	226	9.3	[a] 32	[a] 1.3
Jan. 13	2,428	122	5.0	239	9.8	718	29.6	565	23.3	288	11.9	183	7.5	180	7.4	133	5.5
Jan. 20	2,442	116	4.7	266	10.9	747	30.6	587	24.0	268	11.0	168	6.9	153	6.3	137	5.6
Jan. 27	2,385	93	3.9	248	10.4	794	33.3	559	23.5	280	11.7	172	7.2	125	5.2	114	4.8
Feb. 3	2,468	146	5.9	233	9.4	797	32.3	595	24.1	303	12.3	161	6.5	122	5.0	111	4.5
Feb. 10	2,481	152	6.1	218	8.8	740	29.8	571	23.0	322	13.0	195	7.9	161	6.5	122	4.9
Feb. 17	2,513	212	8.4	281	11.2	757	30.1	511	20.3	306	12.2	182	7.3	140	5.6	124	4.9
Feb. 24	2,411	221	9.2	285	11.8	732	30.4	511	21.2	245	10.2	172	7.1	131	5.4	114	4.7
Mar. 3	2,438	199	8.2	288	11.8	706	28.9	489	20.0	294	12.1	181	7.4	155	6.4	126	5.2
Mar. 10	2,413	202	8.4	255	10.6	695	28.8	529	21.9	269	11.1	184	7.6	161	6.7	118	4.9
Mar. 17	2,434	252	10.4	215	8.8	676	27.8	550	22.6	327	13.4	180	7.4	130	5.3	104	4.3
Mar. 24	2,274	239	10.5	158	6.9	631	27.8	496	21.9	294	12.9	171	7.5	151	6.6	134	5.9
Mar. 31	2,341	275	11.7	184	7.9	610	26.1	571	24.4	284	12.1	177	7.6	115	4.9	125	5.3
Apr. 7	2,355	356	15.1	155	6.6	571	24.3	558	23.7	309	13.1	208	8.8	135	5.7	[c] 63	[c] 2.7
Apr. 14	2,342	407	17.4	156	6.7	608	25.9	491	21.0	265	11.3	171	7.3	122	5.2	122	5.2
Apr. 21	2,363	439	18.6	118	5.0	511	21.6	539	22.8	311	13.2	202	8.5	126	5.3	117	5.0
Apr. 28	2,355	520	22.1	102	4.3	505	21.5	516	21.9	326	13.8	156	6.6	118	5.0	112	4.8
May 5	2,363	529	22.4	107	4.5	495	21.0	545	23.1	268	11.3	170	7.2	123	5.2	126	5.3
May 12	2,372	533	22.5	81	3.4	436	18.4	560	23.6	308	13.0	171	7.2	149	6.3	134	5.6
May 19	2,416	543	22.5	94	3.9	474	19.6	510	21.1	344	14.2	191	7.9	134	5.6	126	5.2
May 26	2,371	529	22.3	69	2.9	335	14.1	484	20.4	402	17.0	268	11.3	157	6.6	127	5.4
June 2	2,277	511	22.4	64	2.8	343	15.1	504	22.1	395	17.3	251	11.0	167	7.4	[a] 42	[a] 1.9
June 9	2,293	503	21.9	69	3.0	274	12.0	505	22.0	403	17.6	223	9.7	181	7.9	135	5.9
June 16	2,287	520	22.8	56	2.4	338	14.8	468	20.5	375	16.4	243	10.6	170	7.4	117	5.1
June 23	2,620	730	27.9	89	3.4	382	14.6	453	17.2	400	15.3	252	9.6	198	7.6	116	4.4
June 30	2,541	741	29.2	101	4.0	396	15.5	410	16.1	323	12.7	281	11.1	180	7.1	109	4.3
July 7	2,499	797	31.9	87	3.5	363	14.5	407	16.3	359	14.4	276	11.0	195	7.8	[a] 15	[a] .6
July 14	2,390	729	30.5	88	3.7	216	9.0	324	13.6	347	14.5	234	9.8	252	10.5	200	8.4
July 21	2,476	729	29.4	57	2.3	213	8.6	355	14.3	396	16.0	240	9.7	294	11.9	192	7.8
July 28	2,608	741	28.4	72	2.7	247	9.5	462	17.7	365	14.0	281	10.8	294	11.3	146	5.6
Aug. 4	2,584	723	28.0	77	3.0	280	10.8	418	16.2	402	15.6	288	11.1	244	9.4	152	5.9
Aug. 11	2,517	721	28.6	87	3.5	300	11.9	380	15.1	412	16.4	366	14.6	210	8.3	[d] 41	[d] 1.6
Aug. 18	2,219	632	28.5	41	1.8	199	9.0	329	14.8	327	14.7	273	12.3	237	10.7	181	8.2
Aug. 25	2,224	623	28.0	29	1.3	144	6.5	351	15.8	343	15.4	305	13.7	252	11.3	177	8.0
Sept. 1	2,205	599	27.2	34	1.5	133	6.0	288	13.1	382	17.3	331	15.0	249	11.3	189	8.6
Sept. 8	2,266	596	26.3	37	1.6	183	8.1	387	17.1	449	19.8	328	14.5	241	10.6	[a] 45	[a] 2.0
Sept. 15	2,223	562	25.3	37	1.7	170	7.6	389	17.5	396	17.8	279	12.6	221	9.9	169	7.6
Sept. 22	2,266	563	24.9	45	2.0	170	7.5	357	15.8	414	18.2	309	13.6	246	10.9	162	7.1

[a] Holiday week. Number of mines working full time reduced by observance of the holiday.

[b] Week of miners' election day. Many union mines closed on that day.

[c] Many mines in union districts shut down on Apr. 2 in observance of the Eight-Hour Day.

[d] Many mines shut down Aug. 10 in tribute to the late President Harding.

TABLE 53.—*Number and percentage of mines reporting weekly to the Geological Survey that were closed and number working part time and full time, August, 1920, to December, 1923*—Continued

Week ended—	Total number reporting	Mines shut down entire week		Mines working													
				1 and less than 8 hours		8 and less than 16 hours		16 and less than 24 hours		24 and less than 32 hours		32 and less than 40 hours		40 and less than 48 hours		Full time of 48 hours or more	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Percent
1923																	
Sept. 29	2,319	594	25.6	53	2.3	200	8.6	356	15.4	388	16.7	312	13.5	263	11.3	153	6.6
Oct. 6	2,307	620	26.9	50	2.2	187	8.1	358	15.5	407	17.6	315	13.7	227	9.8	143	6.2
Oct. 13	2,317	640	27.6	52	2.2	207	8.9	363	15.7	386	16.7	289	12.5	223	9.6	157	6.8
Oct. 20	2,307	672	29.1	57	2.5	201	8.7	312	13.5	362	15.7	301	13.0	237	10.3	165	7.2
Oct. 27	2,383	726	30.5	56	2.4	199	8.4	337	14.1	346	14.5	312	13.1	218	9.1	189	7.9
Nov. 3	2,343	717	30.5	56	2.4	229	9.8	338	14.4	314	13.4	262	11.2	217	9.3	210	9.0
Nov. 10	2,365	768	32.5	50	2.1	178	7.5	354	15.0	317	13.4	264	11.2	240	10.1	194	8.2
Nov. 17	2,332	747	32.0	65	2.8	230	9.9	351	15.0	336	14.4	258	11.1	228	9.8	[a] 117	[a] 5.0
Nov. 24	2,410	735	30.5	54	2.2	228	9.5	403	16.7	329	13.7	245	10.2	218	9.0	198	8.2
Dec. 1	2,318	760	32.8	70	3.0	242	10.4	386	16.7	333	14.4	258	11.1	231	10.0	[a] 38	[a] 1.6
Dec. 8	2,318	785	33.9	49	2.1	216	9.3	300	12.9	314	13.5	259	11.2	217	9.4	178	7.7
Dec. 15	2,293	761	33.2	51	2.2	202	8.8	310	13.5	322	14.1	279	12.2	191	8.3	177	7.7
Dec. 22	2,250	740	32.9	38	1.7	155	6.9	272	12.1	331	14.7	289	12.9	235	10.4	190	8.4
Dec. 29	2,314	918	39.6	58	2.5	293	12.7	391	16.9	341	14.7	198	8.6	111	4.8	[a] 4	[a] .2

[a] Holiday week. Number of mines working full time reduced by observance of the holiday.

NUMBER AND OUTPUT OF PRODUCERS AS DISTINCT FROM MINES

The foregoing statistics represent the number of mines or openings. The number of producing companies is of course much less, because the largest companies operate dozens or scores of mines. No count was made of the number of companies in 1923, but Table 54, analyzing the returns for 1920 for the bituminous-coal industry, may be taken as approximately representative of conditions in 1923. In this table each corporation, partnership, or individual reporting production to the Geological Survey has been classified by the size of his total output. The year 1920 was selected for this analysis because the market conditions in that year were such as to call into active operation all the producing enterprises. Of the 12,122 producing enterprises reported as contributing to the supply of bituminous coal in 1920, 1,440 were country banks (a number that doubtless would have been larger had it been possible to ascertain them all) and 4,405 were wagon mines shipping by rail. The commercial producers proper numbered 6,277. Among them were 795 companies, individuals, or partnerships that produced less than 2,000 tons each. The aggregate contribution of these 795 shippers was 838,000 tons, only 0.15 per cent of the total output. Yet these producers were sufficiently well established, in spite of their small tonnage, to be classed by the Geological Survey as "commercial" or "local commercial," as distinct from the mushroom-like wagon mines. At the other end of the scale were 4 companies that produced 5,000,000 tons or more each. These 4 companies operated 213 mines and contributed 40,505,000 tons to the supply of the country. Between these two groups were ranged the rest of the commercial shippers.

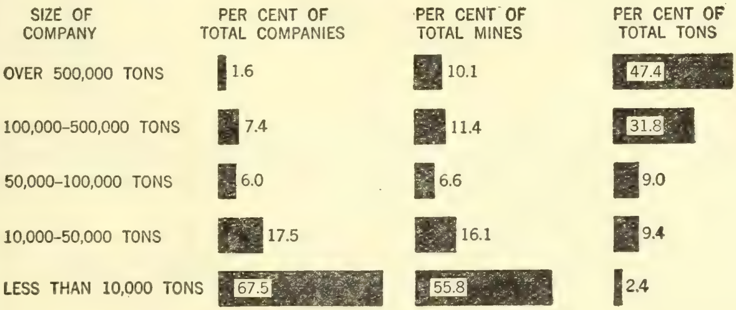

FIGURE 44.—Relative number of large and small bituminous-coal producing companies in 1920, and number of mines and tonnage which they control. Note that the figures represent not mines but companies, and that no account has been taken of intercorporate holdings or affiliations, each corporation being treated as a unit. Wagon-mine producers are included

In the preparation of these tables each corporation reporting to the Geological Survey has been treated as a unit, and no account has been taken of the interlocking ownership or interests of these companies. The tables therefore understate the degree of concentration of ownership in the bituminous-coal mining industry. Such financial affiliation or community of interest is of course common, not merely among the largest companies, but also within the smaller groups producing from 50,000 to 500,000 tons a year.

TABLE 54.—*Bituminous-coal producers in 1920, classified by size of output*

	Number of producers in each class	Number of mines operated	Total output (net tons)
Country banks reporting	1, 440	1, 440	420, 911
Wagon mines shipping by rail, other than local commercial mines	4, 405	4, 405	4, 513, 800
Commercial and local commercial mines producing—			
Less than 2,000 tons	795	798	838, 483
2,000 to 4,999 tons	806	814	2, 604, 260
5,000 to 9,999 tons	748	781	5, 337, 029
10,000 to 49,999 tons	2, 121	2, 381	53, 348, 269
50,000 to 99,999 tons	727	974	51, 242, 458
100,000 to 199,999 tons	543	888	75, 508, 562
200,000 to 299,999 tons	202	424	49, 019, 958
300,000 to 399,999 tons	94	215	32, 965, 932
400,000 to 499,999 tons	52	152	23, 390, 433
500,000 to 599,999 tons	33	98	17, 914, 499
600,000 to 699,999 tons	28	70	18, 007, 916
700,000 to 799,999 tons	20	122	14, 969, 468
800,000 to 899,999 tons	12	89	10, 112, 361
900,000 to 999,999 tons	16	140	14, 149, 119
1,000,000 to 1,249,999 tons	17	128	18, 691, 389
1,250,000 to 1,499,999 tons	9	119	12, 471, 314
1,500,000 to 1,749,999 tons	11	82	17, 935, 541
1,750,000 to 1,999,999 tons	10	97	18, 747, 933
2,000,000 to 2,499,999 tons	10	101	20, 329, 863
2,500,000 to 2,999,999 tons	7	110	21, 697, 649
3,000,000 to 4,999,999 tons	12	125	43, 943, 573
5,000,000 tons or more	4	213	40, 505, 963
	12, 122	14, 766	568, 666, 683

Detailed tables, showing for each State the number of producing companies in each size class, the number of mines operated by them, and their production will be found in Mineral Resources for 1922, Part II, pages 535–544.

By excluding the wagon mines, a comparison of the size of the producing corporations in 1920 and in 1905 is made in Table 55. It indicates that during the 16 years 1905 to 1920 the number of large and small commercial companies had been increasing at about the same rate. This table, like Table 54, counts each producing corporation as a unit regardless of possible affiliations.

TABLE 55.—*Trend of size of producing bituminous-coal corporations, 1905 and 1920*

[Data include commercial and local commercial producers only]

Size of output of corporation	Percentage of total operators		Percentage of total mines		Per cent of total quantity produced	
	1905	1920	1905	1920	1905	1920
Absolute percentage:						
Less than 10,000 tons	42. 8	37. 4	29. 9	26. 8	1. 6	1. 6
10,000 to 49,999 tons	27. 6	33. 8	21. 4	26. 7	7. 8	9. 4
50,000 to 99,999 tons	11. 6	11. 6	11. 1	10. 9	8. 9	9. 1
100,000 to 499,999 tons	15. 2	14. 2	20. 3	18. 8	33. 4	32. 1
500,000 to 999,999 tons	1. 4	1. 7	4. 5	5. 8	10. 8	13. 3
1,000,000 to 4,999,999 tons	1. 3	1. 2	10. 4	8. 6	29. 9	27. 3
5,000,000 tons or more	. 1	. 1	2. 4	2. 4	7. 6	7. 2
	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0
Cumulative percentage:						
Less than 10,000 tons	42. 8	37. 4	29. 9	26. 8	1. 6	1. 6
Less than 50,000 tons	70. 4	71. 2	51. 3	53. 5	9. 4	11. 0
Less than 100,000 tons	82. 0	82. 8	62. 4	64. 4	18. 3	20. 1
Less than 500,000 tons	97. 2	97. 0	82. 7	83. 2	51. 7	52. 2
Less than 1,000,000 tons	98. 6	98. 7	87. 2	89. 0	62. 5	65. 5
Less than 5,000,000 tons	99. 9	99. 9	97. 6	97. 6	92. 4	92. 8
All operators	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0

In sharp contrast to the wide dissemination of ownership in the bituminous coal-mining industry the production of anthracite is concentrated in the hands of a few companies. The following analysis of the returns of 1920 is in general representative of conditions in 1923. As before, the table treats each corporation as a unit without regard to interlocking ownership or interest. Were it possible to combine accurately the several producing interests the degree of concentration of ownership would appear much greater.

TABLE 56.—*Anthracite producers in 1920, classified by size of output*

Size of output (gross tons)	Number of producers	Total output			
		Breakers	Washeries	Dredges	Total
Less than 2,000 tons	17	4, 192		14, 422	18, 614
2,000 to 4,999 tons	12	15, 688		27, 727	43, 415
5,000 to 9,999 tons	18	33, 006		104, 943	137, 949
10,000 to 49,999 tons	38	358, 820	31, 548	420, 732	811, 100
50,000 to 99,999 tons	21	989, 946	365, 481	75, 000	1, 430, 427
100,000 to 199,999 tons	27	3, 650, 850	318, 936		3, 969, 786
200,000 to 299,999 tons	14	3, 404, 033	16, 411		3, 420, 444
300,000 to 399,999 tons	4	1, 276, 145	73, 666		1, 349, 811
400,000 to 499,999 tons	5	1, 538, 324	595, 431		2, 133, 755
500,000 to 599,999 tons	2	1, 120, 253			1, 120, 253
600,000 to 699,999 tons	1	668, 822			668, 822
700,000 to 799,999 tons	2	1, 740, 044	3, 555		1, 743, 599
800,000 to 899,999 tons					
900,000 to 999,999 tons					
1,000,000 to 1,249,999 tons	3	3, 539, 732			3, 539, 732
1,250,000 to 1,499,999 tons	1	1, 437, 040	43, 614		1, 480, 654
1,500,000 to 1,749,999 tons	1	1, 707, 452			1, 707, 452
1,750,000 to 1,999,999 tons					
2,000,000 to 2,499,999 tons					
2,500,000 to 2,999,999 tons					
3,000,000 to 4,999,999 tons	4	15, 892, 066	1, 483, 290	18, 295	17, 393, 651
5,000,000 tons or more	4	36, 291, 640	2, 737, 333		39, 028, 973
	174	73, 668, 053	5, 669, 265	661, 119	79, 998, 437

TABLE 57.—*Anthracite and bituminous-coal producers in 1920, classified by size of output*

Size of output [a]	Number of producers in each size class		Percentage of total output in each size class	
	Anthracite	Bituminous	Anthracite	Bituminous
Less than 10,000 tons	47	8, 194	0. 2	2. 4
10,000 to 49,999 tons	38	2, 121	1. 0	9. 4
50,000 to 99,999 tons	21	727	1. 8	9. 0
100,000 to 499,999 tons	50	891	13. 6	31. 8
500,000 to 999,999 tons	5	109	4. 4	13. 2
1,000,000 to 4,999,999 tons	9	76	30. 2	27. 1
5,000,000 tons or more	4	4	48. 8	7. 1
	174	12, 122	100. 0	100. 0

[a] The unit used in this tonnage classification is the net ton of 2,000 pounds for bituminous-coal producers, and the gross ton of 2,240 pounds for anthracite producers. This difference is offset by the large percentage of the anthracite output that is required for mine fuel.

VALUE OF COAL PRODUCED

DEFINITION OF VALUES REPORTED

The value given in this report is the amount received at the mines f. o. b. cars, less selling expense, and the average value per ton is the average amount received, obtained by dividing the total value by the number of tons sold or produced. Coal used at the mine, coal coked by the producing company, and coal used in some other industry by that company—in all forming a considerable part of the total output—is not sold, and the value placed upon it is either an estimate or the amount at which it is carried on the company's books. Either value is presumably the amount the coal would have brought if it had been sold or the amount other fuel for the purpose stated would have cost if it had been purchased. In other words, the values given represent returns to the operators for coal sold plus the estimated value of that not sold. The value thus fixed is more or less arbitrary and does not necessarily represent the current prices for coal sold commercially. Many mines are owned by consumers who take all or a great part of their output at nominal prices. The output of such "captive mines" is not known accurately, but it is probably between 20 and 25 per cent of the entire production. Even where the coal is actually sold large quantities may be moved on "cost-plus" contracts that provide for prices below the average spot prices in the field or the average prices received for coal delivered under ordinary contracts. The figures in the following tables therefore do not necessarily show prices or even an average of the prices of coal at the mines. Taken over a period of years, however, they do furnish an index to the rise and fall in the value of coal.

The computed "average value per ton" is thus affected by the value placed by the operator upon coal used at the mine but not shipped. In order to ascertain how large an influence the inclusion of this noncommercial coal might have upon the average, the Geological Survey for several years requested operators to give separate statements of value for coal loaded at the mines for shipment, for sale to local trade, and for mine fuel and coal made into beehive coke. It was found, however, that for practical purposes the average value of all the coal produced may be accepted as a measure of the average value of the coal shipped. The values placed by operators on mine fuel and upon the coal coked were generally somewhat less than the average amounts received for the coal shipped, but the quantities to which these lower values applied were so much smaller than the quantity shipped that they affected only slightly the average for all coal produced. Thus in 1921 the average value of all bituminous coal shipped was $2.90 per ton. The average of all coal produced, including mine fuel, local sales, and coal coked, was $2.89, only 1 cent less.

TABLE 58.—*Value of bituminous coal produced in the United States in 1923*

State	Net tons	Value		State	Net tons	Value	
		Total	Average per ton			Total	Average per ton
Alabama	20, 457, 649	$51, 624, 000	$2. 52	New Mexico	2, 915, 173	$10, 668, 000	$3. 66
Alaska	119, 826	755, 000	6. 30	North Carolina	36, 019	132, 000	3. 66
Arkansas	1, 296, 892	5, 192, 000	4. 01	North Dakota	1, 385, 400	3, 275, 000	2. 36
California, Idaho,				Ohio	40, 546, 443	98, 610, 000	2. 43
and Oregon	20, 066	79, 000	3. 94	Oklahoma	2, 885, 038	10, 874, 000	3. 77
Colorado	10, 346, 218	33, 299, 000	3. 22	Pennsylvania	171, 879, 913	472, 217, 000	2. 75
Georgia	75, 620	327, 000	4. 32	South Dakota	10, 379	25, 000	2. 41
Illinois	79, 310, 075	198, 388, 000	2. 50	Tennessee	6, 040, 268	16, 515, 000	2. 73
Indiana	26, 229, 099	65, 046, 000	2. 48	Texas	1, 187, 329	2, 162, 000	1. 82
Iowa	5, 710, 735	20, 517, 000	3. 59	Utah	4, 720, 217	13, 657, 000	2. 89
Kansas	4, 443, 149	14, 275, 000	3. 21	Virginia	11, 761, 643	32, 468, 000	2. 76
Kentucky	44, 777, 317	113, 542, 000	2. 54	Washington	2, 926, 392	10, 894, 000	3. 72
Maryland	2, 285, 926	6, 911, 000	3. 02	West Virginia	107, 899, 941	285, 481, 000	2. 65
Michigan	1, 172, 075	5, 545, 000	4. 73	Wyoming	7, 575, 031	20, 916, 000	2. 76
Missouri	3, 403, 151	11, 575, 000	3. 40				
Montana	3, 147, 678	9, 652, 000	3. 07		564, 564, 662	1,514,621,000	2. 68

ESTIMATES OF VALUE INCLUDED IN THE STATISTICS

If an operator who is known to have produced coal during the year will make no report of the value of his product to the Geological Survey an estimate of the value is included in the total, in order to make it complete. In 1920 and again in 1922 and 1923 a considerable number of operators were unwilling to disclose the amount they had received for their coal, and the number of estimates included in the figures was so great that the readers of these reports should be advised of the method of estimate and of the proportion of the output for which estimate was made. The method used in 1920 and 1922 was to multiply the tons of output reported by the average spot price per ton in the district as quoted by Coal Age. The same method was followed in estimating the value of the coal produced at wagon mines and at new mines from which the Survey heard indirectly through railroads or State mine inspectors, for the information from these sources showed the output but not the value.

In 1923 a different method of estimate was employed. The wagon-mine product was estimated as before at the average spot price for the district. Estimates of the value of the commercial product, however, were based on the average for each county of all reports from operators in the county that did specify value.

The percentage of the total value of the product in each State in 1923 represented in this report by estimates is shown in the following table:

TABLE 59.—*Percentage of total value of bituminous coal produced in 1923 by commercial operators that is represented by estimates*

Alabama	8.3	North Dakota	0.9
Arkansas	15.5	Ohio	3.4
Colorado	7.1	Oklahoma	18.4
Illinois	5.8	Pennsylvania	3.4
Indiana	9.4	South Dakota	1.4
Iowa	.2	Tennessee	6.8
Kansas	12.5	Texas	21.0
Kentucky	14.1	Utah	.2
Maryland	3.5	Virginia	3.2
Missouri	6.8	Washington	16.3
Montana	2.4	West Virginia	8.1
New Mexico	.3	Wyoming	3.3
North Carolina	58.3		
		United States	6.2

Of the $1,514,621,000 given as the total value of bituminous coal at the mines in 1923, $93,959,000, or 6.2 per cent, represents estimates of the value of the output of commercial mines. The total also includes an item of $3,644,000 for the value placed by the Geological Survey on the product of 2,384 wagon mines, which represented 0.2 per cent of the total value. In all, therefore, estimates had to be made for about 6.4 per cent of the total value in 1923. In the average for the whole country the proportion estimated is not large enough to introduce an appreciable error, but in the figures for some of the States the error may be serious.

FLUCTUATIONS IN VALUE

Changes in average value from 1880 to 1923 are shown in Table 60. The figures for anthracite are of doubtful significance, because they include both the steam and domestic sizes. In 1880 the smaller of the steam sizes were thrown upon the culm bank, but to-day all the small coal mined is sold or used, and the percentage of the small sizes is further increased by recovery from the old banks. So far as bituminous coal is concerned, however, the average is fairly comparable. From $1.25 a ton in 1880 it declined to 80 cents in 1898, since when it has been rising. In the same period commodity prices were declining, but not by as great a ratio as the record for bituminous coal here shown. From the late nineties to the outbreak of the World War the increases in value of bituminous coal roughly paralleled the rise in commodity prices. During and after the war several factors caused the value of coal to increase in a greater ratio than the level of commodity prices, and parity between the two had not been reestablished in 1923. The average for coal in that year was $2.68 a net ton at the mine, the lowest since 1919. In comparison with 1922, a decrease of 34 cents a ton is shown.

TABLE 60.—*Average value per net ton of coal at mines, 1880–1923*

Year	Anthracite [a]	Bituminous	Year	Anthracite [a]	Bituminous	Year	Anthracite [a]	Bituminous
1880	$1.47	$1.25	1895	$1.41	$0.86	1910	$1.90	$1.12
1881	2.01	1.12	1896	1.50	.83	1911	1.94	1.11
1882	2.01	1.12	1897	1.51	.81	1912	2.11	1.15
1883	2.01	1.07	1898	1.41	.80	1913	2.13	1.18
1884	1.79	.94	1899	1.46	.87	1914	2.07	1.17
1885	2.00	1.13	1900	1.49	1.04	1915	2.07	1.13
1886	1.95	1.05	1901	1.67	1.05	1916	2.30	1.32
1887	2.01	1.11	1902	1.84	1.12	1917	2.85	2.26
1888	1.91	1.00	1903	2.04	1.24	1918	3.40	2.58
1889	1.44	.99	1904	1.90	1.10	1919	4.14	2.49
1890	1.43	.99	1905	1.83	1.06	1920	4.85	3.75
1891	1.46	.99	1906	1.85	1.11	1921	5.00	2.89
1892	1.57	.99	1907	1.91	1.14	1922	5.01	3.02
1893	1.59	.96	1908	1.90	1.12	1923	5.43	2.68
1894	1.51	.91	1909	1.84	1.07			

[a] Averages for anthracite represent amounts per net ton and include all coal produced.

From Table 61 it will be seen that the decrease was felt in almost every producing State. Only Alabama, Georgia, and Virginia, of the Eastern States, and New Mexico and Colorado, of the Western States, received higher prices in 1923 than the year before.

Wide differences are revealed by Table 61 between the average values of the coal produced in the several States. Of the important Eastern States, Maryland alone reported an average above $3 a ton. In the other Appalachian States—exclusive of Georgia and North Carolina, whose production is insignificant—the values ranged from $2.52 in Alabama to $2.76 in Virginia and $2.75 in Pennsylvania. Average values in the Central Competitive Field were on the whole lower than in the Appalachians. For Illinois the average was $2.50, for Indiana $2.48, for Ohio $2.43, and for the Pittsburgh district as represented by Allegheny and Washington Counties, Pa., $2.70 and $2.51, respectively. This comparison of the Central Competitive Field and the Appalachians suggests that the high wage scales of the union fields were not compensated for by a larger price a ton.

In the States of the western interior, ranging from Iowa to the bituminous fields of Texas, much higher average values prevailed. The average for Iowa was $3.59, for Arkansas $4.01, for Kansas $3.21, and for the bituminous mines in Texas $4.77. The higher values of the western interior region represent not larger profits but higher costs, due to high wage rates, thin beds, and difficult conditions of mining. Among the fields of the far West also values higher than those of the Appalachians and the interior generally prevail. Wyoming reported an average value of $2.76 a ton, the lowest among the Rocky Mountain States but higher than the average for the Appalachians. In Utah the average was $2.89, and in all the other far Western States the average was over $3. Even the lignite produced in North Dakota was reported to have an average value of $2.36 a ton f. o. b. mines, a figure not far below the prices of the bituminous coals of the Central Competitive Field. When it is remembered that the calorific value of North Dakota lignite ranges from 7,000 to 8,000 British thermal units, as against 12,000 to 14,000 British thermal units for the bituminous coals with which it competes, it will be seen that the market for lignite is confined to those areas in which bituminous coal is handicapped by heavy transportation costs.

The highest average value per ton in all the States was $4.73 in Michigan. Here thinness of beds and high wage rates combine to produce high costs, but proximity to favorable markets, which other coals can reach only by paying heavy freight charges, permits the industry to live.

The figures of the table will suggest the great variety of conditions that prevail in bituminous mining, not only as to cost of production but as to differentials in transportation rates to coveted markets, which protect the high-cost producer close to the market against the otherwise overwhelming competition of lower-cost coal coming from greater distances.

TABLE 61.—*Average value per net ton of coal at mines, 1909–1923, by States*

State	1909	1910	1911	1912	1913	1914	1915	1916
Alabama	$1.19	$1.26	$1.27	$1.29	$1.31	$1.34	$1.28	$1.37
Alaska	([a])	([a])	([a])	([a])	([a])	([a])	([c])	4.00
Arkansas	1.48	1.56	1.61	1.71	1.76	1.72	1.79	1.92
California	[b] 2.21	[b] 2.74	[b] 2.00	[b] 2.33	[b] 3.54	[c] 2.85	[c] 2.54	[c] 2.12
Colorado	1.33	1.42	1.45	1.49	1.52	1.66	1.58	1.62
Georgia	1.41	1.46	[d] 1.49	[d] 1.49	1.41	[e] 1.44	1.72	1.79
Idaho	4.27	3.92	[f] 2.68	[f] 3.14	2.43	([a])	([a])	([a])
Illinois	1.05	1.14	1.11	1.17	1.14	1.12	1.10	1.25
Indiana	1.02	1.13	1.08	1.14	1.11	1.10	1.10	1.27
Iowa	1.65	1.75	1.73	1.80	1.79	1.79	1.78	1.86
Kansas	1.44	1.61	1.53	1.62	1.67	1.64	1.66	1.78
Kentucky	.94	.99	.99	1.02	1.05	1.02	1.01	1.19
Maryland	1.11	1.12	1.11	1.18	1.24	1.27	1.28	1.56
Michigan	1.79	1.91	1.78	1.99	1.99	1.99	2.05	2.25
Missouri	1.65	1.79	1.72	1.76	1.73	1.73	1.73	1.91
Montana	1.97	1.82	1.79	1.82	1.74	1.75	1.62	1.73
New Mexico	1.29	1.39	1.44	1.42	1.46	1.61	1.44	1.47
North Carolina			([d])	([d])				
North Dakota	1.56	1.49	1.43	1.53	1.52	1.52	1.45	1.49
Ohio	.99	1.05	1.03	1.07	1.10	1.13	1.08	1.33
Oklahoma	2.00	2.22	2.05	2.14	2.05	2.06	2.01	2.09
Oregon	2.69	3.48	2.32	2.60	2.53	2.78	2.84	2.68
Pennsylvania (bituminous)	.94	1.02	1.01	1.05	1.11	1.07	1.06	1.30
South Dakota					1.96	1.73	1.55	2.03
Tennessee	1.09	1.11	1.12	1.14	1.14	1.14	1.13	1.23
Texas	1.72	1.67	1.66	1.67	1.77	1.69	1.65	1.56
Utah	1.66	1.68	1.69	1.67	1.65	1.59	1.58	1.62
Virginia	.89	.90	.91	.96	1.01	1.01	.98	1.06
Washington	2.54	2.50	2.29	2.39	2.38	2.20	2.17	2.27
West Virginia	.86	.92	.90	.94	1.01	.99	.97	1.18
Wyoming	1.55	1.55	1.56	1.58	1.56	1.55	1.46	1.55
Total bituminous	1.07	1.12	1.11	1.15	1.18	1.17	1.13	1.32
Pennsylvania anthracite [g]	1.84	1.90	1.94	2.11	2.13	2.07	2.07	2.30

[a] Included with California.
[b] California includes Alaska.
[c] California includes Alaska, Idaho, and Nevada in 1914 and 1915; Idaho in 1916, 1917, 1918, 1919, 1920; and Idaho and Oregon in 1921, 1922, and 1923.
[d] Georgia includes North Carolina.
[e] Average for total output, including refuse from washery. The average, excluding refuse, was $1.71.
[f] Idaho includes Nevada.
[g] These values represent amounts per net ton and include all coal produced.

TABLE 61.—*Average value per net ton of coal at mines, 1909-1923, by States*—Continued

State	1917	1918	1919	1920	1921	1922	1923	
							Average	Increase or decrease
Alabama	$2.27	$2.85	$2.96	$3.65	$3.08	$2.34	$2.52	+$0.18
Alaska	4.92	5.45	5.66	5.83	6.46	5.43	6.30	+.87
Arkansas	2.56	3.67	3.70	4.56	4.37	4.14	4.01	−.13
California	[c]2.30	[c]2.70	[c]3.38	[c]4.36	[c]4.66	[c]3.87	[c]3.94	+[c].07
Colorado	2.22	2.69	2.78	3.49	3.55	3.16	3.22	+.06
Georgia	2.53	3.59	3.71	5.00	2.14	4.06	4.32	+.26
Idaho	([a])	([a])	([a])	([a])	([a])	([a])	([a])	([a])
Illinois	1.88	2.32	2.30	3.08	2.74	2.89	2.50	−.39
Indiana	1.99	2.29	2.22	3.16	2.57	2.85	2.48	−.37
Iowa	2.35	3.02	3.09	3.94	3.81	3.72	3.59	−.13
Kansas	2.31	2.91	3.05	3.87	3.85	3.66	3.21	−.45
Kentucky	2.17	2.55	2.46	4.11	2.69	3.02	2.54	−.48
Maryland	2.46	2.77	2.73	4.63	3.61	3.37	3.02	−.35
Michigan	3.22	3.83	3.88	4.93	4.87	5.05	4.73	−.32
Missouri	2.43	3.02	3.21	4.16	3.92	3.81	3.40	−.41
Montana	2.11	2.53	2.67	3.16	3.26	3.19	3.07	−.12
New Mexico	1.86	2.68	3.11	3.68	3.91	3.49	3.66	+.17
North Carolina	--------	4.75	3.84	7.02	5.76	4.94	3.66	−1.28
North Dakota	1.80	2.45	2.50	2.87	2.69	2.65	2.36	−.29
Ohio	2.48	2.58	2.22	3.82	2.65	3.23	2.43	−.80
Oklahoma	2.81	3.64	3.83	4.80	4.62	4.11	3.77	−.34
Oregon	3.38	2.81	3.40	4.49	([a])	([a])	([a])	([a])
Pennsylvania (bituminous)	2.44	2.59	2.42	3.77	2.78	3.11	2.75	−.36
South Dakota	2.90	2.80	3.17	3.60	2.81	2.84	2.41	−.43
Tennessee	2.19	2.83	2.77	4.02	3.35	2.89	2.73	−.16
Texas	1.77	2.63	2.69	3.75	2.64	2.32	1.82	−.50
Utah	2.07	2.71	2.76	3.22	3.35	3.14	2.89	−.25
Virginia	2.00	2.51	2.55	3.99	3.06	2.58	2.76	+.18
Washington	2.68	3.46	3.58	3.88	4.03	3.98	3.72	−.26
West Virginia	2.32	2.56	2.49	4.34	2.84	2.93	2.65	−.28
Wyoming	1.93	2.39	2.60	2.98	3.24	3.04	2.76	−.28
Total bituminous	2.26	2.58	2.49	3.75	2.89	3.02	2.68	−.34
Pennsylvania anthracite [g]	2.85	3.40	4.14	4.85	5.00	5.01	5.43	+.42

[a] Included with California.

[c] California includes Alaska, Idaho, and Nevada in 1914 and 1915; Idaho in 1916, 1917, 1918, 1919, 1920; and Idaho and Oregon in 1921, 1922, and 1923.

[g] These values represent amounts per net ton and include all coal produced.

SPOT PRICES OF BITUMINOUS COAL

The figures of average value collected by the Geological Survey are a composite of business covered by contract or trade connections of long standing at stable prices and business on the "open market," termed by the trade "spot sales." The percentage of coal moving under contract varies greatly from time to time and from district to district. There are no exact statistics of the relative proportions of spot and contract shipments, but it has been frequently stated that under ordinary conditions from 70 to 75 per cent of the total output moves under contract.

Concerning the prices of contract coal little information is available. The trade quotations deal rather with the current spot price f. o. b. mine. The spot price reflects the momentary condition of the market, as interpreted by the buyer seeking low prices, on the one hand, and by the seller attempting to place his coal at the maximum profit, on the other. Much significance therefore attaches to the course of spot prices as an index to the state of trade. The spot price should not be taken, however, as a measure of the average profit of the coal producer.

In the following table is given the average spot price of bituminous coal f. o. b. mine for each month of the 18 years 1906 to 1923, as published by Coal Age. (See also fig. 28.) The average is based upon the quotations reported by the correspondents of that journal for 14 coals representing nearly 90 per cent of the output of bituminous coal in the United States, weighted first with respect to the proportions of slack, prepared, and run of mine normally shipped, and second with respect to the quantity of each of these classes normally produced. For 1919 to 1923 the figures are those published currently by the Coal Age. From 1906 to 1918 they have been compiled by C. E. Lesher, F. G. Tryon, and W. F. McKenney, of the Geological Survey.[19]

TABLE 62.—*Monthly average spot price of bituminous coal f. o. b. mines, 1906–1923, as published by Coal Age*

Month	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	$1.10	$1.28	$1.09	$1.06	$1.24	$1.16	$1.14	$1.46	$1.21
February	1.09	1.21	1.07	1.05	1.23	1.11	1.22	1.22	1.16
March	1.27	1.14	1.05	1.04	1.25	1.08	1.64	1.17	1.17
April	1.46	1.12	1.05	1.05	1.26	1.06	1.30	1.17	1.16
May	1.21	1.11	1.03	1.03	1.19	1.05	1.11	1.15	1.16
June	1.14	1.10	1.03	1.02	1.18	1.05	1.09	1.14	1.12
July	1.06	1.10	1.02	1.00	1.18	1.03	1.04	1.18	1.12
August	1.11	1.13	1.04	1.00	1.20	1.02	1.05	1.22	1.13
September	1.15	1.20	1.06	1.01	1.32	1.03	1.09	1.23	1.11
October	1.29	1.30	1.05	1.04	1.27	1.04	1.21	1.29	1.13
November	1.30	1.29	1.05	1.09	1.23	1.09	1.30	1.31	1.10
December	1.32	1.15	1.04	1.09	1.22	1.09	1.29	1.26	1.11
Average	1.21	1.18	1.05	1.04	1.23	1.07	1.21	1.23	1.14

Month	1915	1916	1917	1918	1919	1920	1921	1922	1923
January	$1.13	$1.53	$4.15	$2.48	$2.57	$2.57	$3.26	$2.25	$4.38
February	1.12	1.40	4.18	2.53	2.49	2.58	2.77	2.20	3.59
March	1.09	1.27	3.89	2.58	2.47	2.58	2.63	2.12	3.20
April	1.08	1.24	3.21	2.64	2.43	3.85	2.62	2.24	2.84
May	1.07	1.21	4.14	2.67	2.38	4.59	2.68	3.11	2.68
June	1.07	1.26	4.00	2.57	2.40	7.18	2.52	3.31	2.56
July	1.05	1.22	3.17	2.58	2.47	8.24	2.40	4.67	2.40
August	1.07	1.30	3.24	2.58	2.76	9.51	2.42	6.13	2.39
September	1.10	1.57	2.02	2.58	2.91	8.52	2.37	5.08	2.46
October	1.12	2.26	2.02	2.58	3.09	7.78	2.33	4.48	2.28
November	1.17	3.87	2.48	2.58	2.57	5.87	2.35	4.11	2.25
December	1.33	4.01	2.48	2.58	2.58	4.38	2.26	4.05	2.18
Average	1.12	1.85	3.25	2.58	2.59	5.64	2.55	3.64	2.77

DIFFERENCE BETWEEN SPOT PRICE AND AVERAGE VALUE

The average spot price in January, 1923, was $4.38. By December it had dropped to $2.18. For the first three months the spot price was above the average value for the year, which, as already stated, was $2.68; thereafter the spot price was below the average value. This relation is typical of the fact that the spot price fluctuates more rapidly than the average value of all coal produced. When the market is dull the spot price may fall below the contract level, and therefore below the average receipts from all sales. In times of active demand it rises far above the contract level. A comparison of the spot prices, as measured by the Coal Age average for the 14 representative coals, and the Geological Survey's figures of average receipts from sales of all coals produced is made in the following table. In 6 out of the 18 years shown the spot price has been below the average value. In one year, 1918, the two figures were exactly the same, because the maximum prices set by the Fuel Administration applied to both spot and contract business, with the exception of bona fide contracts entered into prior to the establishment of Government prices. In 11 out of the 18 years the spot price was the higher of the two.

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[19] See U. S. Geol. Survey Mineral Resources, 1918, prices of coal and coke, 1913–1918, by C. E. Lesher; 1922, coal, by F. G. Tryon and S. A. Hale.

Over a period of years the average spot price is not equal to the average value but is distinctly higher. This relation is explained by the fact that the spot price does not fall as far below the average value during periods of dull market as it rises above the average value during periods of intense demand. Prices can not for long remain below the cost of production, less perhaps depletion and depreciation, but there is theoretically no upper limit to which they can not rise. During the shortage and runaway market of 1920 prices of $17 a ton f. o. b. mines were frequently quoted and sales were no doubt made at still higher figures.

In general it may be said that years in which the spot price has been above the average value of all coals produced have been years of relatively large profit and that years in which the spot price falls below the average value have been years of depression and financial distress.

Variations in costs and margins from 1913 to 1922 were discussed in the report on coal in 1922.[20]

TABLE 63.—*Average spot price and average amount received per ton for bituminous coal, 1906–1923*

Year	Coal Age's average spot price	Average amount received	Difference	Year	Coal Age's average spot price	Average amount received	Difference
1906	$1.21	$1.11	+$0.10	1916	$1.85	$1.32	+$0.53
1907	1.18	1.14	+.04	1917	3.25	2.26	+.99
1908	1.05	1.12	−.07	1918	2.58	2.58	
1909	1.04	1.07	−.03	1919	2.59	2.49	+.10
1910	1.23	1.12	+.11	1920	5.64	3.75	+1.89
1911	1.07	1.11	−.04	1921	2.55	2.89	−.34
1912	1.21	1.15	+.06	1922	3.67	3.02	+.65
1913	1.23	1.18	+.05	1923	2.77	2.68	+.09
1914	1.14	1.17	−.03				
1915	1.12	1.13	−.01	Average 18 years	2.02	1.79	+.23

MONTHLY AVERAGE EXPORT PRICES OF BITUMINOUS COAL

In presenting for the first time the study of spot prices prior to 1913 [21] it was pointed out that the data available become less and less satisfactory as they are pursued back to the earlier years and that none of the trade papers appear to have carried regular quotations of market prices prior to 1905 or 1906. In order to throw light on the fluctuations in current market prices, particularly in the pre-war period, a study has been made of the average value of the monthly exports of bituminous coal, the results of which are presented in

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[20] U. S. Geol. Survey Mineral Resources, 1922, pt. 2, pp. 555–557, 1924.
[21] Idem, p. 552.

Table 64. By using this index the course of prices may be followed back to 1902. Prior to that year exports of anthracite and bituminous coal were not separately reported, and the total for the two is meaningless. The figures represent the declared value of the coal exported divided by the total number of tons. They are here reduced to a net-ton basis, in order to facilitate comparison with the spot prices at the mines. The value reported includes transportation charges to the seaport or the Canadian frontier. They should be therefore roughly comparable with average prices f. o. b. vessels at Hampton Roads, Philadelphia, and New York. The figures are affected by changes in the level of freight rates, but except for certain periods of general readjustment freight rates are constant from month to month.

It is necessary to show the average value of exports to Canada separately from that of the exports to other countries. The Canadian business reflects the changes of the Lake and eastern inland trade. Its most conspicuous feature is a regular seasonal rhythm. From a low point in June, July, and August the average value of exports to Canada has commonly risen to a high point in December, January, February, and March, though this seasonal change has been much less conspicuous since 1914 than formerly.

The figure for exports to other countries represents for all practical purposes the sea-borne trade of the north Atlantic ports. A very small percentage goes from other ports and across the Mexican frontier, but its effect upon the month to month variation in price is small. In common with spot prices f. o. b. mine of coal sold in tidewater markets,[22] the export tidewater price exhibits no seasonal rhythm. It does indicate a period of high prices following the anthracite strike of 1902. The temporary drop in the months of August to November, 1902, is not believed to indicate the course of the market at that time. On account of the shortage created by the anthracite suspension, exports practically ceased, and the average for this period is based upon so small a tonnage that it means little. The peak in the tidewater record for March and April, 1912, registers the joint influence of a suspension in the Pennsylvania anthracite mines and a general strike of the British miners.

The average value of coal exported as thus computed includes both spot and contract sales, and the fluctuations in both the Canadian and tidewater export values have thus been less sudden and less violent than the fluctuations in the average spot price at the mines. Thus during the shortage of 1915–1917 the average spot price f. o. b. mine reached its peak in February, 1917, whereas the average value of both Canadian and offshore exports continued to rise until the final months of 1917. It should be remembered in considering the average value of monthly exports that the figures reported by the customs officials do not always exactly correspond with the calendar months. They represent the export declarations received and tabulated in a certain period of time, which in general corresponds to the calendar month, but occasionally the statistical month lags behind the calendar month. This fact explains why some of the corresponding peaks of the two sets of figures that are clearly associated with a common cause fail to coincide exactly—for example, the sharp peak early in 1912.

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[22] Tryon, F. G., and McKenney, W. F., Economic phases of coal storage; paper read before Fuels Section, Am. Soc. Mech. Engineers, Dec. 5, 1923.

The fact that the export figures include both spot and contract coal suggests that they may give a more accurate indication of the trend in average value than appears in spot prices f. o. b. mines alone. If their statistical peculiarities are kept in mind, it is believed that the average values of export coal will throw considerable light on current changes in the coal market. For the years prior to 1906 they afford the most inclusive and reliable indicator of price fluctuations that can now be obtained.

TABLE 64.—*Average value per net ton of bituminous coal exported to Canada and to all other destinations, by months, 1902–1923*

[Computed from records of Bureau of Foreign and Domestic Commerce. Figures represent value at port, including transportation, and are therefore affected by changes in freight rates as well as f. o. b. mine prices. They include both spot and contract shipments]

Month	1902		1903		1904		1905	
	Canada	Others	Canada	Others	Canada	Others	Canada	Others
January	$2.11	$2.48	$2.38	$2.92	$2.44	$2.79	$2.40	$2.52
February	1.96	2.51	2.32	2.90	2.31	2.71	2.36	2.60
March	1.92	2.53	2.43	2.89	2.36	2.55	2.35	2.55
April	2.30	2.53	2.26	2.91	2.46	2.55	2.26	2.56
May	2.28	2.51	2.28	3.09	2.47	2.54	2.05	2.59
June	2.39	2.76	2.17	3.22	2.31	2.84	2.08	2.57
July	2.33	2.94	2.20	3.06	2.25	2.96	2.05	2.68
August	2.45	2.54	2.27	3.19	2.16	2.66	2.01	2.64
September	2.36	2.61	2.31	3.06	2.19	2.76	2.14	2.52
October	2.29	2.68	2.34	2.85	2.25	2.67	2.14	2.58
November	2.36	2.54	2.24	2.64	2.30	2.59	2.22	2.58
December	2.37	2.99	2.40	2.72	2.40	2.60	2.28	2.82
Average	2.28	2.60	2.28	2.94	2.30	2.67	2.15	2.60

Month	1906		1907		1908		1909	
January	$2.39	$2.65	$2.25	$2.56	$2.32	$2.59	$2.30	$2.65
February	2.58	2.62	2.37	2.58	2.33	2.60	2.38	2.67
March	2.36	2.53	2.41	2.58	2.34	2.51	2.29	2.82
April	2.14	2.51	2.20	2.61	2.34	2.56	2.17	2.50
May	2.11	2.54	2.13	2.52	2.14	2.47	2.12	2.50
June	2.06	2.46	2.12	2.60	2.13	2.49	2.10	2.40
July	2.26	2.43	2.10	2.56	2.12	2.58	2.02	2.42
August	2.07	2.48	2.08	2.51	2.10	2.46	2.09	2.39
September	2.08	2.54	2.16	2.67	2.11	2.51	2.05	2.46
October	2.10	2.55	2.14	2.71	2.16	2.58	2.06	2.50
November	2.16	2.52	2.20	2.59	2.18	2.54	2.17	2.49
December	2.19	2.60	2.24	2.67	2.29	2.67	2.30	2.51
Average	2.19	2.54	2.17	2.60	2.19	2.55	2.13	2.51

Month	1910		1911		1912		1913	
January	$2.30	$2.46	$2.46	$2.37	$2.45	$2.40	$2.35	$2.53
February	2.33	2.42	2.45	2.36	2.47	2.44	2.43	2.52
March	2.29	2.40	2.43	2.39	2.43	2.74	2.46	2.49
April	2.17	2.41	2.16	2.42	2.35	2.93	2.21	2.52
May	2.13	2.37	2.13	2.37	2.11	2.47	2.11	2.50
June	2.08	2.41	2.04	2.36	2.01	2.36	2.08	2.56
July	2.02	2.38	2.06	2.34	1.95	2.41	2.09	2.54
August	2.03	2.43	2.09	2.38	2.08	2.39	2.08	2.58
September	2.04	2.42	2.10	2.38	2.09	2.43	2.07	2.56
October	2.13	2.45	2.15	2.41	2.18	2.45	2.18	2.61
November	2.06	2.43	2.22	2.37	2.33	2.48	2.13	2.58
December	2.31	2.41	2.37	2.35	2.30	2.48	2.23	2.59
Average	2.12	2.41	2.17	2.38	2.17	2.55	2.16	2.55

TABLE 64.—*Average value per net ton of bituminous coal exported to Canada and to all other destinations, by months, 1902–1923*—Continued

Month	1914		1915		1916		1917		1918	
	Canada	Others	Canada	Others	Canada	Others	Canada	Others	Canada	Others
January	$2.09	$2.63	$1.95	$2.84	$1.96	$2.68	$2.62	$3.47	$2.99	$4.31
February	2.18	2.65	1.97	2.73	1.68	2.63	2.75	3.34	2.93	4.86
March	1.85	2.63	1.98	2.76	1.45	2.70	2.70	3.90	2.94	5.05
April	1.89	2.68	1.93	2.68	1.55	2.71	2.52	3.92	3.03	4.93
May	1.99	2.68	1.90	2.67	1.71	2.68	2.83	3.97	2.94	4.95
June	1.89	2.65	1.87	2.67	1.72	2.69	2.98	4.43	3.08	5.13
July	1.92	2.64	1.90	2.65	1.69	2.78	3.28	4.36	3.23	5.28
August	1.95	2.74	1.84	2.65	1.71	2.73	3.32	4.51	3.28	5.14
September	1.92	2.71	1.91	2.66	1.71	2.83	3.26	4.49	3.30	5.10
October	2.01	2.76	1.81	2.61	1.72	2.99	3.38	4.15	3.23	5.44
November	1.97	2.77	1.91	2.64	1.98	3.41	3.40	4.10	3.23	5.62
December	1.98	2.84	1.92	2.62	2.19	3.45	3.14	4.16	3.23	5.63
Average	1.96	2.70	1.89	2.67	1.75	2.83	3.11	4.05	3.15	5.11

Month	1919		1920		1921		1922		1923	
January	$3.32	$5.69	$3.77	$5.72	$5.73	$7.95	$4.34	$5.83	$5.61	$6.00
February	3.28	5.60	3.77	5.83	5.39	7.38	4.74	5.48	5.80	5.96
March	3.87	5.52	3.78	5.97	5.29	7.09	4.68	5.05	5.77	5.75
April	3.82	5.05	4.02	6.55	4.71	6.60	4.03	4.88	5.38	5.98
May	3.33	5.07	4.13	7.29	4.39	6.19	4.01	4.83	4.70	5.78
June	3.23	4.93	4.69	8.62	3.94	5.91	4.55	5.73	4.51	5.18
July	3.22	4.94	5.56	10.84	3.98	6.21	4.79	5.33	4.40	5.10
August	3.28	5.24	5.95	12.01	3.98	6.16	6.09	5.69	4.35	4.92
September	3.32	5.45	6.00	11.82	4.12	6.43	5.99	5.93	4.50	5.04
October	3.34	5.62	6.06	12.20	4.06	6.01	5.56	6.22	4.47	4.69
November	3.58	5.69	5.90	11.12	4.31	5.75	5.78	5.69	4.39	4.59
December	3.52	5.56	5.83	9.28	4.13	5.75	5.72	5.92	4.59	4.45
Average	3.35	5.35	5.36	9.75	4.42	6.51	5.30	5.39	4.76	5.30

DISTRIBUTION OF COAL

Complete statistics of the distribution of coal have not been collected since 1918, when the Geological Survey published a report "Coal in 1918, Part B, Distribution and consumption." The broader features of distribution, such as the shipments to the Lakes and tidewater and the movement to New England, have been set forth at intervals in the Survey's weekly coal reports, but no attempt will be made to summarize them here.

There is, however, certain information about the distribution of coal collected as an incident to the reports on production. Since 1890 the Survey has ascertained the quantity shipped, the quantity made into coke at the mines, the local sales, and the quantity consumed by the collieries themselves. The proportions devoted to these four purposes change very slowly, but over the 34 years covered by the record, as shown in Table 65, there has been a notable decrease in the percentage used at the mines and a corresponding increase in the percentage shipped. Thus, in 1890, as shown in Table 65, the shipments constituted 78.5 per cent of the total production, and in 1923 they had risen to 89.6 per cent. The principal factor in this change has been the gradual displacement of the beehive by the by-product coke ovens. Although the percentage of the entire output made into coke of all kinds has been singularly constant, the proportion made into beehive coke at the mines has fallen from 13.8 per cent in 1890 to 4.9 per cent in 1923. It reached its lowest point in

1921; in that year the demand for coke was curtailed by the business depression, and beehive coke, which had become an auxiliary source of supply subordinate to by-product coke, felt the depression to a peculiar degree.

The item of local sales includes coal furnished to the employees of the mining companies or to other domestic consumers in the neighborhood who can be served without shipment by rail. More important, it includes deliveries of railway fuel direct to locomotive tenders at the tipple. Some millions of tons of locomotive fuel is purchased in this way. Local sales also include the quantity consumed by affiliated industrial plants situated at the coal mines, an arrangement much favored in the manufacture of clay products. A recent development that promises to increase greatly is the location of power plants at the mines and the delivery of coal direct from the mine car to the boiler room or stock pile. In 1923 the local sales amounted to 3.9 per cent of the total output of the country.

The consumption of the mines themselves for power and heat is a small and relatively constant part of the total production. In 1890 1.4 per cent of the bituminous output was required to raise and prepare the coal. Increasing use of power in mining operations resulted in a gradual increase in the percentage consumed by the mines, which seems to have reached the maximum about 1919, when 2.4 per cent of the total tonnage raised went for mine fuel. Since then the quantity consumed by the mines has shown a remarkable decrease, partly because of more attention to fuel economy by the engineers in charge of mine power plants, but chiefly, no doubt, because of the tendency to purchase power from central electric stations, rather than to generate it in isolated plants at the mines. Several mining districts are now receiving practically their entire supply of power from a public-utility distributing system, and the economies of diverse load and large-scale generating plants indicate that this practice will become more and more general. It is well illustrated by Logan County, W. Va., where 13,604,000 tons of coal was produced in 1923, with an expenditure of but 21,325 tons for power and heat at the mines themselves, or less than 0.2 per cent of the production. Over the country as a whole the bituminous mines required 8,765,000 tons for power and heat in 1923, an average of 1.6 per cent of the production.

TABLE 65.—*Disposition of total output of bitumnious coal, 1890–1923, in per cent*

Year	Loaded at mines for shipment	Made into coke at mines	Sold to local trade	Used at mine for steam and heat	Year	Loaded at mines for shipment	Made into coke at mines	Sold to local trade	Used at mine for steam and heat
1890	78.5	13.8	6.3	1.4	1917	85.2	9.1	3.5	2.2
1895	78.7	13.6	6.2	1.5	1918	86.8	7.8	3.2	2.2
1900	81.5	13.0	3.7	1.8	1919	87.8	5.9	3.9	2.4
1905	80.9	13.5	3.4	2.2	1920	88.8	5.4	3.7	2.1
1910	82.2	12.5	3.0	2.3	1921	91.8	2.1	3.9	2.2
1915	85.8	9.2	2.8	2.2	1922	90.9	3.1	4.1	1.9
1916	84.3	10.4	3.2	2.1	1923	89.6	4.9	3.9	1.6

BITUMINOUS COAL AND LIGNITE LOADED FOR SHIPMENT BY RAILROADS AND WATERWAYS

According to reports made to the Geological Survey by the coal operators, the quantity of bituminous coal and lignite loaded for shipment by railroads in 1923 amounted to 488,974,496 tons. The quantity loaded for shipment by waterways was 16,884,799 tons, making a total loaded at the mines for shipment of 505,859,295 tons. (See Table 66.)

The shipments by rail, which are summarized by railroads in the accompanying tables, include all coal loaded on cars at the mines. A small part of the coal shipped is carried only a short distance, perhaps only switched from the tipple to coke ovens near by or to some adjacent industrial plant, but the greater part is moved a considerable distance from the mines. As these statistics include coal used by railroads that serve the coal mines, not all the shipments furnished revenue to the railroads, as coal for "company use" is nonrevenue freight. The statistics of coal traffic published by the railroad companies usually show only revenue freight and include coal received from connecting lines as well as that originating at mines on the lines reporting. For that reason the figures given in the following table may differ from those compiled by the railroads.

The railroads listed are those reported by the operators, and only a few reports of loadings on subsidiary roads have been consolidated under the name of the parent road. The shipments over the Coal & Coke Railroad have been included under the Baltimore & Ohio; and those over the Vandalia; the Pittsburgh, Cincinnati, Chicago & St. Louis; the Pennsylvania Co.; the Ohio River & Western; and the Wheeling Terminal have been included under the Pennsylvania System. The Chicago, Terre Haute & Southeastern, over which operators of Indiana reported shipping 5,199,000 tons in 1920, was leased in 1921 by the Chicago, Milwaukee & St. Paul Railway, and the two are shown combined for 1923 under the name of the latter road.

For a number of other important groupings of railroads no attempt has been made to consolidate the several members into a total for the system. Thus the shipments on the line of the Oregon-Washington Railroad & Navigation Co. and the Oregon Short Line are shown separately from those over the Union Pacific; likewise the Toledo & Ohio Central, Zanesville & Western, Kanawha & Michigan, and Kanawha & West Virginia are shown separately. The statistics for the Cleveland, Cincinnati, Chicago & St. Louis Railroad are here shown exclusive of the Evansville, Indianapolis & Terre Haute Railroad.

The West Side Belt Railroad is not combined with the Pittsburgh & West Virginia Railroad. To the figures for the Southern Railway should be added those for the Alabama Great Southern, Northern Alabama, Cincinnati, New Orleans & Texas Pacific, and Harriman & Northeastern to approximate the total for the Southern System. These illustrations will indicate the compilations of individual entries in the table necessary to give the total tonnage for a particular railroad interest. The Geological Survey can give no guaranty that the relative proportions reported as loaded on the parent road and on its subsidiary are correct, for operators served by a subsidiary may sometimes report the name of the subsidiary and sometimes the name of the parent company.

Coal loaded at mines of the Tennessee Coal, Iron & Railroad Co. is here shown under the name of that company rather than under the Birmingham Southern, the corporate designation of its railroad subsidiary. The figures for the Chicago & Eastern Illinois Railroad include coal loaded in cars of the Elgin, Joilet & Eastern and moved by the latter road over the rails of the Chicago & Eastern Illinois under a trackage agreement.

The quantities shown in the following table as shipped by waterways do not all agree with the statistics on river traffic published by the United States Engineer Office. The shipments of coal on Monongahela River, according to the United States Engineer Office at Pittsburgh, amounted to 18,344,000 tons in 1923. The records of the Engineer Office should be accepted as a correct measure of the river traffic. The differences between these records and the reports of the operators to the Geological Survey are due to various causes, in part to the fact that shipments of coal loaded in cars at the mines and later transferred to boats would be classed by the Survey as "rail" and by the Engineer Office as "river."

TABLE 66.—*Bituminous coal loaded for shipment, 1923, by railroads and waterways, in net tons*

Route	State	Quantity	
		By State	Total for route
Railroads			
Akron, Canton & Youngstown	Ohio	33, 710	33, 710
Alabama Central	Alabama	85, 755	85, 755
Alabama Great Southern	do	34, 374	34, 374
Alaska	Alaska	103, 176	103, 176
Altoona & Northern	Pennsylvania	3, 980	3, 980
Ann Arbor	Michigan	4, 350	4, 350
Arkansas Western	Arkansas	787	787
Ashland Coal & Iron Co	Kentucky	141, 311	141, 311
Atchison, Topeka & Santa Fe	Colorado	589, 504	4, 200, 743
	Illinois	366, 592	
	Kansas	991, 976	
	Missouri	536, 842	
	New Mexico	1, 647, 160	
	Oklahoma	68, 669	
Atlanta, Birmingham & Atlantic	Alabama	162, 277	162, 277
Ballard & Thompson	Utah	83, 749	83, 749
Baltimore & Ohio	Illinois	1, 629, 584	42, 235, 029
	Indiana	413, 649	
	Kentucky	122, 666	
	Maryland	48, 600	
	Ohio	10, 552, 029	
	Pennsylvania	8, 683, 451	
	West Virginia	20, 785, 050	
Bessemer & Lake Erie	Pennsylvania	4, 546, 404	4, 546, 404
Bevier & Southern	Missouri	409, 671	409, 671
Big Sandy & Cumberland	Kentucky	11, 788	11, 788
Big Sandy & Kentucky River	do	33, 946	33, 946
Buffalo & Susquehanna	Pennsylvania	1, 601, 790	1, 601, 790
Buffalo Creek & Gauley	West Virginia	600, 190	600, 190
Buffalo, Rochester & Pittsburgh	Pennsylvania	6, 917, 822	6, 917, 822
Cambria & Indiana	do	3, 065, 137	3, 065, 137
Campbell's Creek	West Virginia	617, 609	617, 609
Carolina, Clinchfield & Ohio	Kentucky	96, 255	2, 787, 229
	Virginia	2, 690, 974	
Caseyville	Illinois	12, 695	12, 695
Castleman Valley	Maryland	12, 015	12, 015
Central Indiana	Indiana	28, 900	28, 900
Central of Georgia	Alabama	1, 130, 260	1, 178, 432
	Georgia	48, 172	
Chattanooga & Montlake	Tennessee	37, 152	37, 152
Cheat Haven & Bruceton	West Virginia	296, 263	296, 263

TABLE 66.—*Bituminous coal loaded for shipment, 1923, by railroads and waterways, in net tons*—Continued

Route	State	Quantity	
		By State	Total for route
Railroads—Continued			
Chesapeake & Ohio	Kentucky	4, 142, 397	32, 471, 561
	West Virginia	28, 329, 164	
Cheswick & Harmar	Pennsylvania	501, 955	501, 955
Chicago & Alton	Illinois	4, 658, 346	4, 746, 387
	Missouri	88, 041	
Chicago & Eastern Illinois	Illinois	5, 184, 577	10, 913, 791
	Indiana	5, 729, 214	
Chicago & Illinois Midland	Illinois	2, 319, 379	2, 319, 379
Chicago & Northwestern	do	4, 165, 054	5, 489, 696
	Iowa	1, 138, 783	
	Wyoming	185, 859	
Chicago, Burlington & Quincy	Colorado	449, 898	15, 444, 931
	Illinois	12, 712, 110	
	Iowa	489, 975	
	Missouri	337, 784	
	Wyoming	1, 455, 164	
Chicago, Indianapolis & Louisville	Indiana	1, 616, 143	1, 616, 143
Chicago, Milwaukee & St. Paul	Illinois	780, 502	9, 640, 216
	Indiana [a]	6, 793, 225	
	Iowa	866, 115	
	Missouri	66, 582	
	Montana	993, 747	
	North Dakota	103, 081	
	South Dakota	2, 000	
	Washington	34, 964	
Chicago, Peoria & St. Louis	Illinois	460, 790	460, 790
Chicago, Rock Island & Gulf	Texas	21, 279	21, 279
Chicago, Rock Island & Pacific	Arkansas	28, 405	2, 401, 269
	Colorado	34, 546	
	Illinois	43, 035	
	Iowa	1, 348, 933	
	Missouri	47, 839	
	Oklahoma	898, 511	
Cincinnati, Indianapolis & Western	Illinois	107, 226	320, 341
	Indiana	213, 115	
Cincinnati, New Orleans & Texas Pacific	Tennessee	75, 884	75, 884
Cleveland & Marietta	Ohio	15, 065	15, 065
Cleveland, Cincinnati, Chicago & St. Louis	Illinois	7, 143, 766	8, 078, 285
	Indiana	934, 519	
Colfax Northern	Iowa	81, 852	81, 852
Colorado & Southeastern	Colorado	514, 858	514, 858
Colorado & Southern	do	2, 346, 995	2, 346, 995
Colorado & Wyoming	do	380, 236	380, 236
Colorado, Wyoming & Eastern	do	55, 500	55, 500
Crystal River & San Juan	do	1, 000	1, 000
Cumberland	Kentucky	114, 726	114, 726
Cumberland & Manchester	do	180, 583	180, 583
Cumberland & Pennsylvania	Maryland	1, 221, 554	1, 238, 515
	Pennsylvania	16, 961	
Dardanelle & Russellville	Arkansas	59, 821	59, 821
Dent's Run	Pennsylvania	26, 492	26, 492
Denver & Intermountain	Colorado	139, 706	139, 706
Denver & Rio Grande Western	do	2, 928, 478	5, 533, 320
	New Mexico	32, 310	
	Utah	2, 572, 532	
Denver & Salt Lake	Colorado	745, 808	745, 808
Des Moines & Central Iowa	Iowa	190, 167	190, 167
Detroit, Toledo & Ironton	Ohio	126, 897	126, 897
East Broad Top R. R. & Coal Co	Pennsylvania	555, 124	555, 124
Eastern Kentucky	Kentucky	13, 683	13, 683
Eastern Railway & Lumber Co	Washington	16, 376	16, 376
East St. Louis & Suburban	Illinois	483, 873	483, 873
Elgin, Joliet & Eastern	do	158, 377	158, 377
El Paso & Southwestern	New Mexico	682, 294	682, 294
Erie	Ohio	174, 234	2, 014, 024
	Pennsylvania	1, 839, 790	
Evansville & Ohio Valley	Indiana	66, 992	66, 992
Evansville, Indianapolis & Terre Haute	do	1, 378, 709	1, 378, 709
Evansville, Suburban & Newburgh	do	132, 820	132, 820
Federal Valley	Ohio	86, 374	86, 374
Fort Dodge, Des Moines & Southern	Iowa	63, 085	63, 085
Fort Smith & Western	Oklahoma	99, 296	99, 296
Fort Smith, Subiaco & Rock Island	Arkansas	12, 950	12, 950
Galveston, Harrisburg & San Antonio	Texas	17, 890	17, 890
Grand Prairie Branch	Arkansas	40, 538	40, 538

[a] Chicago, Terre Haute & Southeastern Ry.

TABLE 66.—*Bituminous coal loaded for shipment, 1923, by railroads and waterways, in net tons*—Continued

Route	State	Quantity	
		By State	Total for route
Railroads—Continued			
Great Northern	Montana	682, 284	1, 138, 910
	North Dakota	286, 576	
	Washington	170, 050	
Greenbrier & Eastern	West Virginia	607, 452	607, 452
Harriman & Northeastern	Tennessee	290, 802	290, 802
Hartland	West Virginia	89, 730	89, 730
Hocking Sunday Creek Traction	Ohio	1, 312	1, 312
Hocking Valley	do	3, 479, 957	3, 479, 957
Houston & Texas Central	Texas	134, 964	134, 964
Houston East & West Texas	do	98, 550	98, 550
Huntington Broad Top Mountain	Pennsylvania	656, 447	656, 447
Illinois Central	Alabama	200, 272	22, 637, 003
	Illinois	15, 733, 696	
	Indiana	547, 610	
	Kentucky	6, 155, 425	
Illinois Central Electric	Illinois	11, 227	11, 227
Illinois Traction	do	990, 538	990, 538
Indiana County Street Railway	Pennsylvania	4, 973	4, 973
Indian Creek & Northern	West Virginia	51, 263	51, 263
Indian Creek Valley	Pennsylvania	245, 245	245, 245
International & Great Northern	Texas	179, 491	179, 491
Interstate	Kentucky	171, 000	2, 696, 791
	Virginia	2, 525, 791	
Iowa Southern Utilities Co	Iowa	76, 340	76, 340
Jefferson Southwestern	Illinois	3, 062	3, 062
Johnstown & Stony Creek	Pennsylvania	195, 057	195, 057
Joplin & Pittsburg	Kansas	48, 084	48, 084
Kanawha & Michigan	Ohio	605, 642	927, 466
	West Virginia	321, 824	
Kanawha & West Virginia	do	81, 637	81, 637
Kanawha Central	do	40, 269	40, 269
Kanawha, Glen Jean & Eastern	do	633, 322	633, 322
Kansas City, Clay County & St. Joseph	Missouri	1, 800	1, 800
Kansas City, Clinton & Springfield	do	6, 927	6, 927
Kansas City Southern	Kansas	418, 277	722, 281
	Missouri	213, 964	
	Oklahoma	90, 040	
Kansas, Oklahoma & Gulf	do	219, 204	219, 204
Kentucky & Tennessee	Kentucky	784, 593	784, 593
Kentucky & West Virginia Power Co	West Virginia	42, 009	42, 009
Kentucky, Rockcastle & Cumberland	Kentucky	9, 926	9, 926
Lake Erie, Franklin & Clarion	Pennsylvania	555, 566	555, 566
Lenox	Kentucky	958	958
Ligonier Valley	Pennsylvania	639, 939	639, 939
Litchfield & Madison	Illinois	1, 183, 285	1, 183, 285
Long Fork	Kentucky	926, 574	926, 574
Louisville & Nashville	Alabama	4, 557, 027	29, 693, 720
	Illinois	838, 299	
	Kentucky	23, 060, 179	
	Tennessee	971, 131	
	Virginia	267, 084	
Louisville, Henderson & St. Louis	Kentucky	175, 711	175, 711
Louisiana Ry. & Navigation Co. of Texas	Texas	44, 065	44, 065
M. E. McNeals	Pennsylvania	30, 608	30, 608
Marion & Eastern	Illinois	87, 600	87, 600
Michigan Central	Michigan	579, 235	579, 235
Midland Valley	Arkansas	251, 561	402, 301
	Oklahoma	150, 740	
Miller's Creek	Kentucky	356, 143	356, 143
Minneapolis & St. Louis	Illinois	644, 082	1, 047, 687
	Iowa	403, 605	
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota	277, 446	277, 446
Missouri-Illinois	Illinois	389, 131	389, 131
Missouri, Kansas & Texas	Kansas	95, 954	821, 268
	Missouri	91, 428	
	Oklahoma	452, 524	
	Texas	181, 362	
Missouri Pacific	Arkansas	581, 849	5, 996, 132
	Illinois	3, 487, 105	
	Kansas	1, 126, 402	
	Missouri	778, 851	
	Oklahoma	21, 925	
Mobile & Ohio	Alabama	696, 795	1, 338, 088
	Illinois	641, 293	
Monongahela	Pennsylvania	3, 162, 747	7, 652, 349
	West Virginia	4, 489, 602	
Monongahela Valley Traction Co	Ohio	1, 200	2, 800
	West Virginia	1, 600	

TABLE 66.—*Bituminous coal loaded for shipment, 1923, by railroads and waterways, in net tons*—Continued

Route	State	Quantity	
		By State	Total for route
Railroads—Continued			
Monongahela West Penn Public Service Co. Electric	West Virginia	3,623	3,623
Montana	Arkansas	32,885	32,885
Montana, Wyoming & Southern	Montana	417,388	417,388
Montour	Pennsylvania	5,562,085	5,562,085
Morehead & North Fork	Kentucky	4,763	4,763
Morgan & Fentress	Tennessee	35,913	35,913
Morgan Run	Ohio	1,966	1,966
Morgantown & Kingwood	West Virginia	173,470	173,470
Morgantown & Wheeling	do	717,238	717,238
Nashville, Chattanooga & St. Louis	Alabama	432	1,213,495
	Tennessee	1,213,063	
New Castle & Ohio River	Ohio	2,131	2,131
New Haven & Dunbar	Pennsylvania	86,674	86,674
New Mexico Midland	New Mexico	89,275	89,275
New York Central	Ohio	4,222,902	14,195,823
	Pennsylvania	7,410,259	
	West Virginia	2,562,662	
New York, Chicago & St. Louis	Illinois	699,779	708,232
	Indiana	8,453	
Norfolk & Western	Kentucky	3,853,774	30,115,196
	Ohio	6,890	
	Virginia	2,666,623	
	West Virginia	23,587,909	
Norfolk & Southern	North Carolina	29,419	29,419
Northern Alabama	Alabama	577,876	577,876
Northern Pacific	Montana	841,410	3,087,334
	North Dakota	461,215	
	Washington	1,784,709	
Norton & Northern	Virginia	84,780	84,780
Ohio & Kentucky	Kentucky	28,237	28,237
Ohio River Electric Rwy. & Power Co	Ohio	365	365
Ohio Service Electric	do	10,000	10,000
Oneida & Western	Tennessee	6,363	6,363
Oregon Short Line	Wyoming	1,379,734	1,379,734
Oregon-Washington Railroad & Navigation Co	Washington	249,750	249,750
Owensboro & Nashville	Kentucky	174,760	174,760
Pacific Coast	Washington	425,558	425,558
Pennsylvania (includes Ohio River & Western, Pittsburgh, Cincinnati, Chicago & St. Louis, and Wheeling Terminal).	Illinois	1,007,435	75,344,209
	Indiana	5,468,307	
	Ohio	8,311,118	
	Pennsylvania	59,272,058	
	West Virginia	1,285,291	
Peoria & Pekin Union	Illinois	567,647	567,647
Peoria, Hanna City & Western	do	620,199	620,199
Pere Marquette	Michigan	502,613	502,613
Peru, La Salle & Deer Park	Illinois	61,257	61,257
Pittsburgh & Lake Erie	Pennsylvania	6,353,614	6,353,614
Pittsburgh & Shawmut	do	1,632,556	1,632,556
Pittsburgh & Susquehanna	do	200,786	200,786
Pittsburgh & West Virginia	Ohio	590,951	2,883,543
	Pennsylvania	1,853,569	
	West Virginia	439,023	
Pittsburgh, Chartiers & Youghiogheny	Pennsylvania	842,391	842,391
Pittsburg County Ry. Co	Oklahoma	9,229	9,229
Pittsburgh, Lisbon & Western	Ohio	22,646	175,913
	Pennsylvania	153,267	
Pittsburgh, Shawmut & Northern	do	560,385	560,385
Pond Fork & Bald Knob	West Virginia	4,848	4,848
Preston	Maryland	8,963	97,883
	West Virginia	88,920	
Puget Sound Electric	Washington	16,577	16,577
Quincy, Omaha & Kansas City	Missouri	47,840	47,840
Reynoldsville & Falls Creek	Pennsylvania	237,309	237,309
Rio Grande & Eagle Pass	Texas	42,913	42,913
Rio Grande Southern	Colorado	58,047	58,047
Rock Island Southern	Illinois	119,903	119,903
Rural Valley	Pennsylvania	971,997	971,997
St. Louis & Belleville Electric	Illinois	321,504	321,504
St. Louis & Hannibal	Missouri	9,548	9,548
St. Louis & O'Fallon	Illinois	720,822	720,822
St. Louis & Ohio River	do	301,199	301,199
St. Louis-San Francisco	Alabama	2,572,799	5,212,981
	Arkansas	236,554	
	Kansas	1,396,391	
	Missouri	294,988	
	Oklahoma	712,249	
St. Louis Southwestern of Texas	Texas	228,786	228,786
St. Louis, Troy & Eastern	Illinois	759,259	759,259
San Antonio & Aransas Pass	Texas	41,900	41,900
San Antonio Southern	do	27,306	27,306

TABLE 66.—*Bituminous coal loaded for shipment, 1923, by railroads and waterways, in net tons*—Continued

Route	State	Quantity	
		By State	Total for route
Railroads—Continued			
Sandy Valley & Elkhorn	Kentucky	1, 474, 019	1, 474, 019
Santa Fe, Raton & Eastern	New Mexico	121, 426	121, 426
Scotts Run	West Virginia	3, 302, 119	3, 302, 119
Seaboard Air Line	Alabama	3, 500	3, 500
Sewell Valley	West Virginia	244, 201	244, 201
Southeastern Ohio Electric	Ohio	1, 021	1, 021
Southern	Alabama	4, 623, 697	11, 874, 017
	Illinois	618, 221	
	Indiana	1, 617, 711	
	Kentucky	758, 297	
	Tennessee	2, 205, 758	
	Virginia	2, 050, 333	
Southern Illinois Railway & Power Co	Illinois	500	500
Southern Pacific	Oregon	10, 006	10, 006
Springfield Terminal	Illinois	245, 128	245, 128
Strouds Creek & Muddlety	West Virginia	37, 000	37, 000
Susquehanna & New York	Pennsylvania	9, 315	9, 315
Tennessee	Tennessee	229, 545	229, 545
Tennessee Central	do	536, 506	536, 506
Tennessee Coal, Iron & R. R. Co	Alabama	3, 084, 901	3, 084, 901
Texas & Pacific	Texas	81, 354	81, 354
Texas Short Line	do	57, 041	57, 041
Thomas & Sayreton	Alabama	435, 256	435, 256
Toledo & Ohio Central	Ohio	1, 532, 138	1, 532, 138
Toledo, Peoria & Western	Illinois	258, 192	258, 192
Trinidad Electric	Colorado	3, 985	3, 985
Uintah	do	202	202
Union	Pennsylvania	561, 158	561, 158
Union Pacific	Colorado	1, 141, 361	5, 444, 015
	Kansas	15, 708	
	Utah	42, 962	
	Wyoming	4, 243, 984	
Unity	Pennsylvania	642, 485	642, 485
Ursina & North Fork	do	13, 469	13, 469
Utah	Utah	1, 480, 050	1, 480, 050
Virginian	Virginia	7, 106	7, 772, 036
	West Virginia	7, 764, 930	
Wabash	Illinois	2, 798, 872	3, 336, 689
	Iowa	368, 647	
	Missouri	169, 170	
Wabash, Chester & Western	Illinois	490, 898	490, 898
Washington Run	Pennsylvania	390, 806	390, 806
Western Allegheny	do	438, 434	438, 434
Western Maryland	Maryland	890, 556	5, 089, 727
	Pennsylvania	694, 851	
	West Virginia	3, 504, 320	
West Side Belt	Pennsylvania	1, 869, 202	1, 869, 202
West Virginia Northern	West Virginia	339, 907	339, 907
Wheeling & Lake Erie	Ohio	5, 498, 366	5, 498, 366
Woodstock & Blocton	Alabama	166, 383	166, 383
Woodward Iron Co	do	1, 056, 347	1, 056, 347
Wyoming	Wyoming	75	75
Youngstown & Ohio River	Ohio	544, 944	544, 944
Zanesville & Western	do	1, 279, 461	1, 279, 461
		488, 974, 496	488, 974, 496
Waterways			
Allegheny River	Pennsylvania	732, 891	732, 891
Big Sandy River	West Virginia	76	76
Coquille River	Oregon	1, 250	1, 250
Green River	Kentucky	36, 357	36, 357
Illinois River	Illinois	16, 349	16, 349
Kanawha River	West Virginia	812, 824	812, 824
Kentucky River	Kentucky	44, 910	44, 910
Monongahela River	Pennsylvania	14, 525, 841	14, 525, 841
Muskingum River	Ohio	559	559
Ohio River	Indiana	2, 282	555, 195
	Kentucky	264, 808	
	Ohio	172, 008	
	Pennsylvania	10, 243	
	West Virginia	105, 854	
Tennessee River	Tennessee	12, 000	12, 000
Tradewater River	Kentucky	12, 173	12, 173
Warrior River	Alabama	132, 683	132, 683
Miscellaneous waterways	Alaska	1, 691	1, 691
		16, 884, 799	16, 884, 799
Grand total		505, 859, 295	505, 859, 295

STOCKS OF COAL HELD BY CONSUMERS

For convenient reference, a summary of the stocks of coal held by consumers, as published by the Geological Survey and Bureau of the Census, is given in Table 67. (See also fig. 25.) Copies of the detailed reports from which the table is extracted may be had on application to the Director, Bureau of Mines, Washington, D. C.

TABLE 67.—*Stocks of bituminous coal in hands of commercial consumers and stocks of anthracite and bituminous coal in retail dealers yards, 1916–1924*

[From periodic stock reports of the U. S. Geological Survey. Coal for steamship fuel, on lake docks, in transit, and in the bins of householders is not included]

Date	Total stock, estimated (tons) [a]	Days' supply at rate of consumption on date of stock taking								
		By-product coke plants	Steel plants	Other industrials	Coal-gas plants	Electric utilities	Coal dealers, bituminous	Railroads	Total bituminous	Anthracite in retail yards
1916, Oct. 1	27,000,000	(b)	25		(b)	(b)	(b)	20	(c)	(b)
1917, Oct. 1	28,100,000	(b)	27		(b)	(b)	(b)	18	(d)	(b)
1918, July 15	39,700,000	28	27	48	72	39	15	25	31	(b)
Oct. 1	59,000,000	32	45	71	84	47	28	29	43	(b)
Nov. 11 (Armistice Day)	63,000,000	35	45	71	85	49	37	31	45	(b)
1919, Jan. 1	57,900,000	32	42	65	81	49	39	32	42	36
Apr. 1	40,400,000	23	35	47	58	48	25	(b)	31	31
1920, Mar. 1	24,000,000	15	9	27	31	21	13	11	18	21
June 1	20,000,000	8	11	24	22	22	10	10	15	15
1921, Jan. 1	45,800,000	29	42	64	55	44	30	23	39	24
Apr. 1	39,500,000	28	38	47	66	48	26	24	36	36
Aug. 1	41,000,000	31	46	56	79	44	42	32	39	50
Nov. 1	48,500,000	38	46	67	87	54	46	31	43	47
1922, Jan. 1	48,000,000	42	48	51	89	51	33	35	41	44
Mar. 1	52,500,000	39	48	56	82	54	23	42	43	28
Apr. 1	[e] 63,000,000	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Sept. 1	22,000,000	11	12	32	34	26	11	13	17	5
Oct. 1	26,000,000	14	17	33	38	30	18	15	21	7
Nov. 1	32,000,000	18	21	39	55	32	21	13	23	11
1923, Jan. 1	36,000,000	19	27	40	60	33	18	16	26	11
Feb. 1	38,000,000	20	26	36	62	35	15	18	24	8
Mar. 1	36,000,000	19	26	34	58	34	11	16	22	6
June 1	42,000,000	23	29	39	75	45	27	21	30	19
July 1	46,000,000	26	35	46	89	48	39	28	37	25
Aug. 1	52,000,000	27	35	54	104	52	45	39	44	25
Sept. 1	56,000,000	30	33	56	110	52	38	44	46	21
Oct. 1	60,000,000	33	39	56	91	49	36	41	45	22
1924, Jan. 1	62,000,000	35	43	55	91	51	34	44	46	37
June 1	51,000,000	34	56	53	88	63	40	50	49	49
Sept. 1	47,000,000	30	42	48	90	58	46	42	45	58

[a] The figures for 1918 in this table are based upon an actual count. Beginning with Apr. 1, 1919, the figures are based upon reports from a selected list of 5,000 consumers whose stocks in 1918 bore a known relation to the known total stocks.

[b] No data.

[c] Data incomplete. Estimated as 22 days.

[d] Data incomplete. Estimated as 21 days.

[e] No canvass of consumers was made on this date. Total was estimated from stocks on Mar. 1.

IMPORTS AND EXPORTS OF COAL

IMPORTS

The distribution of coal in international trade is governed largely by transportation cost and very little by tariffs and trade regulations. Many of the principal coal-producing countries import as well as export coal; thus Germany, in the years before the war, though exporting great quantities of fuel over her land frontiers to Austria, Hungary, Russia, Switzerland, and France, still found it advantageous to import some 10,000,000 tons of British coal through her Baltic seaports. The United States has a large exportable surplus, but there are districts in Washington, Idaho, and Montana that depend on imports from Canada.

Under normal conditions of trade the imports fluctuate but little from month to month or from year to year and amount to about 1,300,000 tons annually. The great strike of 1922 created a shortage in the United States severe enough to stimulate importation from Europe, and its influence was felt well into the year 1923. From 1,257,000 net tons in 1921 the imports jumped to 5,060,000 tons in 1922, and even in 1923 they stood at 1,882,000 tons, or fully 500,000 tons above the normal figure. From Table 68 it will be seen that the abnormal sea-borne imported coal of 1923 came almost entirely from England and Scotland, which furnished together 644,000 tons, against 29,000 tons in 1921. This British coal was delivered in New England and New York. Not the least interesting feature of the imports of 1923 was the receipt of 300,360 tons of anthracite. Stray shipments of anthracite are reported by the customs statistics in every year, though their classification as anthracite is sometimes questionable. In 1921 the anthracite thus reported amounted to 8,894 tons (Table 69). About the identity of the 254,000 tons of British anthracite reported in 1923, however, there can be no doubt. It was true anthracite from the Swansea Valley of Wales, although the sizes in which it is prepared differ from those familiar to the American consumer. A much smaller quantity of anthracite, 14,282 net tons, was received from Scotland in 1923.

TABLE 68.—*Bituminous coal imported, 1919–1923, by countries and districts, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Country of origin	1919	1920	1921	1922	1923
North America:					
Canada	924,138	1,123,903	1,092,132	1,555,038	1,099,773
Mexico	33	48	115	147	9
Newfoundland and Labrador	----------	1,240	----------	----------	----------
Cuba	----------	----------	----------	325	133
Dutch West Indies	----------	----------	221	----------	----------
South America:					
Brazil	----------	67	123	20	----------
Chile	2	----------	----------	----------	----------
Peru	----------	----------	----------	----------	728
Venezuela	----------	----------	2	129	----------
Europe:					
Belgium	672	55	1	1,680	504
France	----------	33	875	----------	9
Germany	----------	314	225	2,894	538
Greece	----------	280	----------	----------	----------
Italy	448	----------	1	----------	----------
Malta, Gozo, and Cyprus Islands	168	----------	----------	----------	----------
Netherlands	----------	84	----------	----------	----------
Poland and Danzig	----------	----------	----------	----------	1
Sweden	----------	----------	----------	44	----------
United Kingdom—					
England	2,110	8,287	27,608	2,831,293	545,587
Scotland	----------	----------	1,120	----------	97,968
Ireland	----------	4	----------	457,794	----------
Asia:					
China	----------	3	1,667	6,588	2
Kwangtung, leased territory	----------	----------	8,760	----------	----------
Dutch East Indies	----------	392	----------	----------	----------
Hongkong	----------	----------	56	----------	9,860
Japan	7,411	28,408	50,191	15,428	22,496
Philippine Islands	552	2,240	201	1,230	280
Russia in Asia	----------	17	----------	134	----------
Africa:					
Egypt	----------	----------	301	----------	----------
French Africa	206	----------	----------	----------	----------
Oceania:					
Australia	75,603	76,422	73,976	187,255	89,877
New Zealand	207	3,193	14	----------	14,541
	1,011,550	1,244,990	1,257,589	5,059,999	1,882,306

TABLE 68.—*Bituminous coal imported, 1919-1923, by countries and districts, in net tons*—Continued

District of entry	1919	1920	1921	1922	1923
Maine and New Hampshire	24, 043	59, 781	26, 078	356, 721	261, 338
Vermont	12	1, 193	9	41, 096	
Massachusetts	318	6, 357	301	1, 645, 087	360, 538
Rhode Island				210, 903	65, 295
Connecticut				4, 523	
St. Lawrence	563	2, 998	317	14, 597	
Buffalo		4, 731	17	6, 579	
New York	1, 878	16, 215	1, 939	1, 148, 142	239, 369
Philadelphia	710			218, 361	22, 515
Pittsburgh		17		1	1
Maryland		448	3	89, 589	572
Virginia	448	1, 610		325	
Georgia				90	
Florida			28		
New Orleans	336		347	762	
Galveston		224		2, 520	
San Antonio	33	48	87	147	9
San Diego			2, 240		
Los Angeles				28	
San Francisco	31, 362	18, 567	86, 902	184, 880	62, 271
Oregon	76	4, 595	4, 205	16, 794	7, 093
Washington	289, 527	275, 824	348, 034	455, 363	207, 983
Alaska	48, 708	45, 264	33, 776	34, 251	43, 204
Hawaii	90, 108	101, 038	47, 210	92, 876	85, 314
Montana-Idaho	519, 419	697, 174	702, 707	506, 179	513, 465
Dakota	586	1, 794	2, 896	6, 066	12, 624
Duluth-Superior	1, 603	5, 357	272	17, 740	371
Wisconsin				1, 680	344
Michigan	1, 820	1, 755		2, 918	
Ohio				1, 652	
Porto Rico			221	129	
	1, 011, 550	1, 244, 990	1, 257, 589	5, 059, 999	1, 882, 306

TABLE 69.—*Anthracite imported, 1919–1923, by countries and districts, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Country of origin	1919	1920	1921	1922	1923
Canada	81, 205	30, 853	6, 654	21, 220	19, 118
Costa Rica		2			
Mexico	941	151			99
Other British West Indies		4			
Dutch West Indies	202	112			
Brazil			26		
Chile			1		
Peru		4	3	1	
England	336	369	11	202, 718	253, 828
France			10		
Germany				901	
Scotland	112				14, 282
Spain				34	
China				3	1, 037
Kwangtung, leased territory			9		
Chosen	22				
British India			6		
Japan		238	2, 174		
British South Africa		1			
British West Africa				224	
Australia		14		8, 427	11, 828
Algeria and Tunisia					168
	82, 818	31, 748	8, 894	233, 528	300, 360

TABLE 69.—*Anthracite imported, 1919-1923, by countries and districts, in net tons*—Continued

District of entry	1919	1920	1921	1922	1923
Maine and New Hampshire	1, 691	777	1, 259	32, 031	35, 505
Vermont	3	221	30	532	235
Massachusetts				32, 791	83, 988
Rhode Island				26, 967	17, 306
Connecticut					7, 549
St. Lawrence	65	17	35	54	67
Buffalo			46		176
New York	336	627	67	74, 525	98, 048
Philadelphia					14, 869
Maryland				37, 284	16, 377
New Orleans				224	
South Carolina					224
San Antonio	941	151			99
San Francisco				9, 547	9, 180
Los Angeles					220
Oregon				3	2, 789
Washington	79, 326	28, 407	4, 967	10, 778	1, 867
Alaska				1	
Hawaii			2, 173		
Montana and Idaho		112	40		3, 609
Dakota	69	439		311	7, 650
Duluth-Superior	73	880	238	7, 940	31
Michigan			39	540	571
Porto Rico	314	117			
	82, 818	31, 748	8, 894	233, 528	300, 360

EXPORTS

GENERAL FEATURES

In considering exports the trade of the United States with Canada must be distinguished from that with other countries. Except for the small shipments to Mexico the coal trade with other countries is sea-borne. It is relatively new, fluctuating, and at times speculative. It varies with the buying power of other countries and more particularly with the prices at which European coal is available for export and with the freight rates prevailing for ocean transport. The trade with Canada, on the other hand, is stable and of long standing.

TRADE WITH CANADA

Thus exports to Canada recovered promptly from the strike of 1922. From 10,836,000 tons in the strike year the exports of bituminous coal to Canada rose to 16,854,000 tons in 1923, the largest in any year since the war. Shipments of anthracite to Canada in 1923 were 4,989,000 tons, a figure much in excess of the quantity for 1921 and not far from the average for 1919 and 1920.

The absence of coal deposits in central Canada and the long-standing character of the export movement from the United States to Canada lay a heavy obligation upon the coal trade of this country to continue the movement. Canadian consumers have shared with those of the United States the inconveniences resulting from strikes and car shortages on this side of the boundary, and it is not surprising that the frequent occurrence of these disturbances has awakened among Canadians a desire to be less dependent upon outside sources for their fuel supply. The high-rank coals of Canada are confined to the maritime provinces on the east and British Columbia on the west. A great stretch of central Canada is without coal of any grade, but in the prairie provinces are found enormous reserves of low-rank bituminous coal and lignite, which ultimately may supply some of the markets in the interior provinces now fueled with American coal. For the present and for many years to come, however, the needs of Canada must be treated as no less pressing than those of the several States in framing any emergency program for the production and distribution of coal. The budget of the United States Fuel Administration during the war provided shipments to Canada in the same ratio to estimated requirements that was allotted to the individual States, and the Canadian Government cooperated by imposing the same regulations upon consumers in Canada that were in force in the United States. Again, in the distribution of fuel after the strike of 1922, the program adopted for anthracite placed Canada on the same basis as the several States.

SEA-BORNE EXPORT TRADE

In contrast to the trade with Canada, which proceeds through well-established channels over the same transportation routes and largely from the same producing fields year after year, the sea-borne export coal trade of the United States is beset by many uncertainties. In pre-war years it averaged about 4,000,000 net tons a year. The war at first stimulated but later curtailed exports as the activity of the submarine cut deeply into the world's supply of shipping. In 1919 the off-shore exports were 8,050,000 net tons. In 1920 the export demand was unprecedented, and our sea-borne exports reached the enormous total of 22,059,000 net tons. The next year, in the face of a world-wide industrial depression, they dropped to 9,541,000 tons and would have dropped still lower but for the fact that for three months exports from the United Kingdom were suspended by a strike in that country. The great strike of 1922 dealt the sea-borne export trade a staggering blow. The total dropped to 1,475,000 net tons. The after-effects of the strike continued to handicap the export trade during the first quarter of 1923. Prices continued relatively high until the following spring. The occupation of the Ruhr by the French temporarily revived the overseas demand for American coal, and for four months—April to July—the offshore shipments averaged over 500,000 tons a month (Table 74). Prices, however, declined rapidly in the last half of the year, and in December offshore exports amounted to but 243,000 tons, or at the rate of 2,800,000 tons a year. A contributing cause of this decline in the export trade was the competition of fuel oil, which continued to replace coal for vessel fuel in 1923 and invaded many of the markets formerly reached by American coal.

Practically all our sea-borne exports consist of bituminous coal rather than anthracite, and the trade is largely confined to Hampton Roads, Baltimore, Philadelphia, and Charleston. New York plays little part in the export trade proper but is one of the leading bunkering ports for vessels engaged in foreign commerce.

TABLE 70.—*Bituminous coal exported, 1919–1923, by countries, in net tons* [a]

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Country	1919	1920	1921	1922	1923
North America:					
Bermuda	21,771	54,939	36,738	15,968	16,936
British Honduras	673	493	780	1,900	1,633
Canada	11,949,829	16,230,202	13,396,774	10,836,347	16,854,257
Costa Rica	1,923	15,352	3,613	2,470	3,343
Guatemala	4,360	1,181	2,940	670	134
Honduras	9,360	14,619	15,837	6,512	1,719
Nicaragua	2,269	1,029	2,045	979	3,974
Panama	80,748	173,647	249,568	116,993	21,577
Salvador	2,512	3,502	44	34	3
Greenland	1,363	1,178	795	224	----------
Mexico	113,880	227,598	192,876	101,983	106,006
Miquelon and St. Pierre Islands	----------	----------	----------	----------	9,473
Newfoundland and Labrador	4,712	28,445	5,466	2,388	37,612
West Indies—					
Barbados	120,551	82,276	22,135	20,904	29,974
Jamaica	37,059	92,338	65,690	31,028	35,035
Trinidad and Tobago	46,277	31,849	22,785	19,618	23,885
Other British West Indies	31,403	53,477	8,698	13,938	24,879
Cuba	1,087,967	1,492,548	587,521	519,521	683,893
Dominican Republic	15,333	12,611	9,456	7,893	4,655
Dutch West Indies	27,657	45,222	13,665	32,334	60,282
French West Indies	26,806	50,916	62,520	60,474	87,367
Haiti	----------	1	80	3	2,988
Virgin Islands of the United States	17,188	47,456	26,566	15,683	35,093
	13,603,641	18,660,879	14,726,592	11,807,864	18,044,718
South America:					
Argentina	541,396	1,924,712	842,952	88,448	146,793
Bolivia	----------	----------	----------	----------	584
Brazil	710,202	1,080,821	590,492	170,389	348,011
Chile	104,852	553,416	168,945	52,546	21,984
Colombia	13,255	7,076	12,867	6,325	4,542
Ecuador	3,302	4,733	4,729	4,613	2,238
Falkland Islands	17,033	3,442	----------	----------	----------
Guiana—					
British	4,196	20,086	3,861	3,642	12,282
Dutch	1,121	3,244	2,757	2,129	2,659
Paraguay	----------	7,778	----------	----------	----------
Peru	51,317	39,628	31,530	15,488	11,222
Uruguay	218,397	299,944	98,997	----------	32,810
Venezuela	556	3,164	1,724	26	2,190
	1,665,627	3,948,044	1,758,854	343,606	585,315
Europe:					
Austria	----------	13,182	----------	----------	----------
Austria-Hungary	237	----------	----------	----------	----------
Azores and Madeira Islands	36,799	53,360	90,278	----------	----------
Belgium	224	307,524	26,554	----------	91,280
Czechoslovakia	----------	----------	7,529	----------	----------
Denmark	99,571	1,082,647	171,307	3	----------
Finland	----------	31,229	920	----------	----------
France	586,032	4,083,911	680,435	13,453	943,789
Germany	9,565	86,006	43,292	2,939	375,772
Gibraltar	22,726	92,222	141,420	----------	----------
Greece	53,894	259,096	107,659	11,123	42,740
Hungary	----------	5,817	8,292	----------	----------
Iceland and Faroe Islands	----------	8,010	15,551	----------	----------
Italy	1,828,954	2,674,262	1,735,395	138,973	655,295
Latvia	----------	----------	----------	----------	13,259
Malta, Gozo, etc	----------	----------	7,000	----------	----------
Netherlands	808,854	2,404,581	374,180	2,841	424,397
Norway	179,024	824,623	47,582	----------	2,844
Poland and Danzig	----------	7,573	----------	----------	----------
Portugal	50,599	184,144	112,200	1,421	----------
Rumania	----------	9,238	2	----------	----------
Russia in Europe	----------	69,119	97,819	----------	----------
Spain	20,858	73,789	65,504	----------	40,989
Sweden	283,238	1,396,730	75,107	----------	57,817
Switzerland	592,004	909,812	9,810	----------	----------
Turkey in Europe	4,710	105,728	21,456	----------	----------
United Kingdom—					
England	7,379	36,133	1,138,474	162	9,850
Scotland	----------	22,100	83,324	----------	20,116
Ireland	----------	----------	454,317	----------	----------
	4,584,668	14,740,836	5,515,407	170,915	2,678,148

[a] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade, which aggregated in 1919, 8,223,862 tons; in 1920, 10,485,639 tons; in 1921, 3,453,220 tons; in 1922, 4,614,632 tons; and in 1923, 5,093,024 tons.

TABLE 70.—*Bituminous coal exported, 1919–1923, by countries, in net tons*—Con.

Country	1919	1920	1921	1922	1923
Asia:					
Aden	------	17,773	------	------	------
China	------	11	7,343	------	------
Dutch East Indies	14,808	1,235	14,445	------	------
Far Eastern Republic	------	------	------	12	------
Palestine and Syria	------	------	[b] 7,595	------	------
Russia in Asia	3	6	45	9	------
Turkey in Asia	------	13,156	19,182	------	2,821
	14,811	32,181	48,610	21	2,821
Africa:					
Algeria and Tunisia	------	------	------	7,869	76,925
British Africa—					
West	4,658	3,979	7,439	34	1,144
South	------	728	------	------	------
East	6,915	11,090	------	------	------
Canary Islands	21,937	67,502	192,973	1,782	2,452
Egypt	42,048	701,716	533,344	58,372	25,756
French Africa	58,241	266,735	204,746	22,622	15,710
German Africa	------	7,164	------	------	------
Italian Africa	5,786	------	------	------	------
Morocco	------	------	336	------	------
Portuguese Africa	49,159	36,308	66,284	------	------
	188,744	1,095,222	1,005,122	90,679	121,987
Oceania:					
Australia	------	------	------	------	18,533
New Zealand	56,038	39,918	67,011	------	1,587
Other British Oceania	6	4	11	------	------
Philippine Islands	------	------	9,559	------	------
Other Oceania	1	------	------	------	470
	56,045	39,922	76,581	------	20,590
Grand total	20,113,536	38,517,084	23,131,166	12,413,085	21,453,579

[b] Figures cover period July to December, 1921.

TABLE 71.—*Bituminous coal exported, 1919–1923, by districts, in net tons*[a]

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

District	1919	1920	1921	1922	1923
Georgia	36,901	189,185	10,258	------	------
Maine and New Hampshire	13,304	338	244	301	11,528
Connecticut	------	------	------	83	------
Maryland	1,923,423	4,933,385	1,644,217	103,741	1,589,667
Massachusetts	2,788	45	3,472	28	339
New York	32,790	283,414	69,038	8,756	16,675
Philadelphia	1,135,943	2,756,491	687,391	140,949	339,524
South Carolina	175,247	741,633	336,567	136,776	262,462
Virginia	4,681,488	12,755,689	6,740,444	1,124,511	2,610,243
Florida	45,434	268,432	129,446	53,434	36,020
Galveston	------	217	12	210	3
Mobile	6,971	108,310	19,028	16,298	10,312
New Orleans	17,716	47,153	19,776	9,750	7,950
Sabine	19	159	56	54	34
Arizona	43,505	38,254	26,992	22,317	40,769
El Paso	46,542	137,257	123,530	50,539	39,585
San Antonio	15,094	18,207	15,804	2,523	2,747
Alaska	987	17	50	195	293
Hawaii	6	48	11	------	------
Los Angeles	------	49	7	------	90
Oregon	2,421	392	------	------	------
San Diego	------	174	180	199	32
San Francisco	124	1,185	587	5,852	2,636
Southern California	277	------	------	------	------
Washington	4,738	11,693	16,228	13,105	14,852
Buffalo	2,457,114	3,605,285	3,277,863	3,013,742	3,867,829
Montana and Idaho	------	------	7,426	------	34
Dakota	38,152	23,715	58,517	25,950	87,984
Duluth-Superior	48,873	90,836	119,120	62,152	62,419
Michigan	1,134,576	1,782,437	1,340,509	1,400,105	1,926,314
Wisconsin	------	------	------	112	------
Ohio	5,892,189	7,160,774	5,835,505	4,281,290	6,991,116
Rochester	546,735	1,006,625	468,800	505,475	734,010
St. Lawrence	1,763,756	2,481,550	2,149,468	1,427,060	2,781,926
Vermont	45,694	72,894	30,407	7,578	15,922
Porto Rico	729	1,241	213	------	264
	20,113,536	38,517,084	23,131,166	12,413,085	21,453,579

[a] Amounts stated do not include fuel or bunker coal.

TABLE 72.—*Anthracite exported, 1919–1923, by countries, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

Country	1919	1920	1921	1922	1923
North America:					
Bermuda	3,322	2,119	3,716	----------	2,208
British Honduras	1	----------	690	----------	858
Canada	4,865,912	4,968,282	4,519,216	2,572,450	4,988,837
Costa Rica	----------	2	----------	2	2
Guatemala	57	655	110	184	137
Honduras	1,116	1,397	----------	93	3
Nicaragua	172	225	----------	100	1
Panama	----------	949	1,795	11	----------
Salvador	----------	4	6	9	15
Mexico	4,993	18,266	49,820	6,408	4,232
Miquelon and St. Pierre Islands	412	100	293	138	303
Newfoundland and Labrador	13,681	16,947	17,245	5,903	5,946
West Indies—					
Barbados	340	685	291	151	112
Jamaica	6	109	2	22	----------
Trinidad and Tobago	2	22	----------	----------	----------
Other British West Indies	440	364	2,776	416	162
Cuba	58,079	58,410	53,648	48,748	71,280
Dominican Republic	9,554	7,773	10,531	1,506	10,425
Dutch West Indies	----------	336	444	----------	----------
French West Indies	----------	13,940	----------	----------	----------
Haiti	2	4	1	----------	141
	4,958,089	5,090,589	4,660,584	2,636,141	5,084,662
South America:					
Argentina	28	5,127	1,959	25	84
Bolivia	----------	504	----------	----------	----------
Brazil	1,894	9,966	22	4	----------
Chile	259	1,832	596	----------	505
Colombia	810	289	80	----------	17
Ecuador	----------	964	----------	----------	55
Guiana—					
British	34	----------	----------	----------	----------
Dutch	----------	----------	34	----------	----------
French	----------	----------	----------	140	----------
Peru	448	3,759	----------	----------	----------
Uruguay	----------	90	----------	----------	----------
Venezuela	2	6	11	9	21
	3.475	22,537	2,702	178	682
Europe:					
Austria-Hungary	207	----------	----------	----------	----------
Azores and Madeira Islands	----------	----------	30	----------	----------
Belgium	----------	8,453	----------	----------	----------
Denmark	----------	35,463	3,920	9	----------
Finland	----------	822	----------	----------	----------
France	2,833	73,362	1,594	----------	4,787
Germany	22	352	----------	34	----------
Greece	----------	10,662	----------	----------	----------
Italy	10,478	5,468	174	----------	3
Netherlands	2	48,746	1,278	520	----------
Norway	2	20,595	----------	----------	----------
Portugal	50	1,590	----------	----------	----------
Spain	762	----------	4,767	----------	----------
Sweden	112	44,111	----------	----------	----------
Switzerland	----------	30,754	----------	----------	----------
Turkey in Europe	225	5,154	----------	----------	----------
United Kingdom (England)	----------	2	368	259	4
	14,693	285,534	12,131	822	4,794
Asia:					
Russia in Asia	----------	----------	448	----------	----------
Turkey in Asia	113	1,228	101	----------	----------
Philippine Islands	228	----------	----------	----------	----------
	341	1,228	549	----------	----------
Africa:					
British West Africa	----------	----------	136	----------	----------
Canary Islands	----------	1,105	1,266	----------	----------
Egypt	----------	2,747	----------	12,314	----------
Portuguese Africa	----------	9	----------	----------	----------
Oceania (French)	----------	----------	----------	2	----------
	----------	3,861	1,402	12,316	----------
Grand total	4,976,598	5,403,749	4,677,368	2,649,457	5,090,138

TABLE 73.—*Anthracite exported, 1919–1923, by districts, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

District	1919	1920	1921	1922	1923
Connecticut	------	------	------	34	48
Georgia	2	------	------	------	------
Maine and New Hampshire	1, 469	843	866	812	408
Maryland	2, 733	939	4, 087	12, 314	11, 091
Massachusetts	2, 907	1, 177	983	712	405
New York	79, 502	245, 529	147, 700	66, 391	96, 597
Philadelphia	66, 483	176, 021	72, 844	47, 554	59, 311
South Carolina	1, 633	------	------	------	3, 454
Virginia	7, 476	19, 777	5, 464	------	7, 791
Florida	1, 475	6, 980	30	547	165
Mobile	------	------	------	140	------
New Orleans	2, 027	9, 513	------	236	10
Galveston	------	------	------	1	------
Sabine	1	34	35	------	------
Arizona	55	644	8, 840	3, 381	421
El Paso	988	2, 465	496	1, 667	1, 929
San Antonio	3, 149	14, 254	40, 153	1, 211	1, 607
Oregon	1	6, 441	------	------	------
Los Angeles	------	17	5	2	174
Southern California	169	------	------	------	------
San Diego	------	62	54	65	1
San Francisco	------	132	66	143	39
Washington	392	1, 197	1, 206	137	2, 585
Alaska	------	------	------	2	6
Buffalo	2, 622, 023	2, 622, 543	2, 532, 752	1, 381, 779	2, 619, 713
Dakota	5, 311	7, 763	26, 582	10, 190	40, 369
Duluth-Superior	18, 630	7, 497	9, 025	4, 002	22, 681
Michigan	594	1, 569	3, 230	3, 827	7, 893
Ohio	63, 016	27, 896	24, 687	13, 412	39, 731
Rochester	576, 595	616, 258	427, 467	273, 842	512, 434
St. Lawrence	1, 496, 211	1, 610, 429	1, 350, 470	819, 021	1, 647, 117
Vermont	23, 616	23, 685	20, 326	7, 867	14, 123
Porto Rico	140	84	------	168	35
	4, 976, 598	5, 403, 749	4, 677, 368	2, 649, 457	5, 090, 138

TABLE 74.—*Anthracite and bituminous coal exported to Canada, Mexico, and all other countries, 1919–1923, in net tons*

[Compiled from the records of the Bureau of Foreign and Domestic Commerce]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1919													
Anthracite:													
Canada	405, 740	230, 408	117, 704	316, 083	444, 170	528, 444	542, 349	557, 303	529, 666	476, 572	337, 986	379, 487	4, 865, 912
Mexico	306	170	462	664	113	382	229	396	1, 130	495	178	468	4, 993
Other countries	6, 953	11, 362	13, 776	2, 666	2, 369	2, 407	3, 593	8, 146	17, 761	8, 724	21, 041	6, 895	105, 693
	412, 999	241, 940	131, 942	319, 413	446, 652	531, 233	546, 171	565, 845	548, 557	485, 791	359, 205	386, 850	4, 976, 598
Bituminous (not including fuel or bunker coal):													
Canada	861, 023	500, 000	395, 229	562, 173	1, 218, 589	1, 602, 430	1, 498, 681	1, 498, 208	1, 581, 407	1, 622, 438	375, 918	233, 734	11, 949, 830
Mexico	11, 026	5, 759	6, 080	6, 944	7, 733	16, 029	6, 523	12, 267	12, 199	9, 808	10, 004	9, 508	113, 880
Other countries	480, 501	259, 995	219, 212	339, 346	374, 949	822, 246	765, 267	1, 128, 297	1, 453, 295	1, 654, 602	413, 366	138, 750	8, 049, 826
	1, 352, 550	765, 754	620, 521	908, 463	1, 601, 271	2, 440, 705	2, 270, 471	2, 638, 772	3, 046, 901	3, 286, 848	799, 288	381, 992	20, 113, 536
1920													
Anthracite:													
Canada	326, 527	285, 553	430, 139	371, 300	304, 039	544, 704	665, 218	521, 890	332, 712	456, 239	339, 180	390, 781	4, 968, 282
Mexico	594	380	961	956	158	461	290	429	479	438	4, 570	8, 550	18, 266
Other countries	15, 676	19, 119	38, 944	17, 142	6, 264	28, 220	72, 678	99, 736	31, 071	41, 041	29, 507	17, 803	417, 201
	342, 797	305, 052	470, 044	389, 398	310, 461	573, 385	738, 186	622, 055	364, 262	497, 718	373, 257	417, 134	5, 403, 749
Bituminous (not including fuel or bunker coal):													
Canada	514, 073	606, 222	716, 391	940, 460	802, 426	1, 337, 019	1, 886, 888	2, 091, 047	1, 974, 836	2, 234, 213	1, 634, 498	1, 492, 129	16, 230, 202
Mexico	6, 941	12, 615	17, 580	19, 093	7, 976	7, 842	18, 686	20, 153	17, 748	23, 023	24, 128	51, 812	227, 597
Other countries	878, 053	690, 226	946, 634	1, 763, 883	1, 878, 517	2, 163, 262	2, 078, 044	2, 490, 636	2, 500, 211	2, 872, 553	2, 336, 566	1, 460, 700	22, 059, 285
	1, 399, 067	1, 309, 063	1, 680, 605	2, 723, 436	2, 688, 919	3, 508, 123	3, 983, 618	4, 601, 836	4, 492, 795	5, 129, 789	3, 995, 192	3, 004, 641	38, 517, 084
1921													
Anthracite:													
Canada	305, 732	301, 827	331, 539	394, 317	464, 136	537, 286	428, 324	411, 724	309, 929	338, 922	358, 676	336, 803	4, 519, 215
Mexico	9, 012	8, 508	4, 536	6, 792	5, 602	2, 502	1, 320	3, 066	2, 849	2, 342	744	2, 546	49, 819
Other countries	9, 317	16, 649	8, 818	11, 649	16, 687	15, 616	4, 962	2, 976	6, 946	1, 548	9, 485	3, 681	108, 334
	324, 061	326, 984	344, 893	412, 758	486, 425	555, 404	434, 606	417, 766	319, 724	342, 812	368, 905	343, 030	4, 677, 368

Bituminous (not including fuel or bunker coal):													
Canada	1, 319, 219	704, 323	662, 544	813, 224	1, 259, 155	1, 581, 997	1, 466, 050	1, 477, 378	1, 158, 994	1, 259, 684	997, 574	696, 632	13, 396, 774
Mexico	36, 037	28, 904	14, 209	9, 284	8, 865	19, 970	16, 239	15, 236	15, 331	11, 622	9, 746	7, 433	192, 876
Other countries	1, 163, 006	676, 483	613, 308	793, 754	1, 532, 399	2, 110, 287	1, 485, 699	405, 887	182, 678	218, 634	200, 943	158, 438	9, 541, 516
	2, 518, 262	1, 409, 710	1, 290, 061	1, 616, 262	2, 800, 419	3, 712, 254	2, 967, 988	1, 898, 501	1, 357, 003	1, 489, 940	1, 208, 263	862, 503	23, 131, 166
1922													
Anthracite:													
Canada	245, 567	292, 854	305, 705	121, 085	62, 434	43, 700	16, 884	31, 678	97, 910	448, 281	485, 768	420, 584	2, 572, 450
Mexico	435	114	596	488	213	401	1, 134	305	1, 409	192	912	209	6, 408
Other countries	4, 923	14, 926	23, 822	832	5, 516	1, 017	684	165	11	5, 126	6, 801	6, 776	70, 599
	250, 925	307, 894	330, 123	122, 405	68, 163	45, 118	18, 702	32, 148	99, 330	453, 599	493, 481	427, 569	2, 649, 457
Bituminous (not including fuel or bunker coal):													
Canada	589, 138	740, 091	1, 091, 240	507, 814	304, 804	479, 191	324, 809	418, 420	1, 244, 089	1, 845, 002	1, 750, 540	1, 541, 209	10, 836, 347
Mexico	8, 039	5, 885	8, 836	18, 163	12, 228	6, 649	7, 184	6, 778	5, 327	7, 894	5, 245	9, 755	101, 983
Other countries	124, 006	165, 241	229, 715	274, 817	130, 465	119, 576	78, 248	51, 396	66, 592	84, 060	56, 416	94, 223	1, 474, 755
	721, 183	911, 217	1, 329, 791	800, 794	447, 497	605, 416	410, 241	476, 594	1, 316, 008	1, 936, 956	1, 812, 201	1, 645, 187	12, 413, 085
Fuel or bunker coal loaded on vessels engaged in foreign trade	424, 093	401, 569	464, 746	449, 313	470, 944	409, 116	360, 351	291, 657	291, 528	330, 000	371, 440	349, 875	4, 614, 632
1923													
Anthracite:													
Canada	389, 017	361, 928	440, 437	462, 887	491, 567	460, 897	489, 704	488, 097	187, 897	446, 130	402, 335	367, 941	4, 988, 837
Mexico	205	216	608	709	155	137	227	394	432	290	461	397	4, 231
Other countries	9, 516	7, 849	6, 466	8, 957	7, 589	7, 791	20, 083	7, 081	8, 443	2, 251	10, 964	80	97, 070
	398, 738	369, 993	447, 511	472, 553	499, 311	468, 825	510, 014	495, 572	196, 772	448, 671	413, 760	368, 418	5, 090, 138
Bituminous (not including fuel or bunker coal):													
Canada	1, 121, 848	817, 725	1, 031, 104	996, 688	1, 772, 824	2, 041, 756	1, 902, 764	1, 964, 449	1, 695, 594	1, 397, 706	1, 159, 274	952, 525	16, 854, 257
Mexico	7, 318	4, 817	6, 236	12, 813	12, 668	12, 947	12, 533	7, 120	5, 461	5, 752	6, 860	11, 481	106, 006
Other countries	93, 968	80, 148	329, 027	541, 564	733, 389	654, 318	636, 333	399, 565	279, 799	264, 096	237, 724	243, 385	4, 493, 316
	1, 223, 134	902, 690	1, 366, 367	1, 551, 065	2, 518, 881	2, 709, 021	2, 551, 630	2, 371, 134	1, 980, 854	1, 667, 554	1, 403, 858	1, 207, 391	21, 453, 579
Fuel or bunker coal loaded on vessels engaged in foreign trade	358, 954	352, 782	405, 157	388, 065	512, 624	492, 643	481, 839	506, 754	439, 631	413, 503	393, 138	347, 934	5, 093, 024

In addition to the export trade proper, the United States supplies by sea a small tonnage to the Territories of Alaska, Hawaii, and Porto Rico. As shown in Table 75, the movement to Alaska is relatively steady but that to Hawaii and Porto Rico fluctuates within wide limits. In 1923, 34,000 net tons was shipped coastwise to Alaska, 25,000 tons to Hawaii, and 49,000 tons to Porto Rico. The competition of fuel oil is suggested by the marked decline in the movement to Porto Rico. As late as 1917, 125,000 tons was shipped to Porto Rico, or five times the figure for 1923.

TABLE 75.—*Shipments of coal to Alaska, Hawaii, and Porto Rico, 1910–1923, in net tons*

[Compiled from records of the Bureau of Foreign and Domestic Commerce]

Year	Alaska	Hawaii	Porto Rico	
			Anthracite	Bituminous
1910	32, 098	69, 054	3, 399	117, 678
1911	32, 255	1, 919	2, 704	113, 551
1912	27, 767	1, 137	2, 417	125, 723
1913	69, 066	38, 526	1, 465	131, 105
1914	41, 509	1, 475	4, 717	125, 196
1915	46, 329	4, 773	5, 755	125, 943
1916	44, 934	11, 697	2, 069	168, 367
1917	58, 116	39, 442	125, 635	
1918	51, 520	73, 006	116, 161	
1919	57, 166	42, 495	83, 492	
1920	38, 128	17, 634	104, 021	
1921	24, 278	9, 249	55, 800	
1922	28, 457	846	55, 356	
1923	34, 082	25, 344	49, 302	

WORLD'S PRODUCTION OF COAL

From the information thus far available, the world's production of coal in 1923 appears the greatest on record. The total output, according to the official figures for the principal countries supplemented by preliminary returns for certain others from which more accurate data may later be obtained, is 1,360,000,000 metric tons. This is 4,000,000 tons more than the accepted figure for 1917, and 18,000,000 tons more than the accepted figure for 1913.

It is indeed significant of the economic disorganization wrought by the war that the output five years after the armistice should still be barely what it was before the war broke out, because normally the world's production of coal increases by leaps and bounds. In the 20 years preceding 1914 the average annual increase was 38,000,000 tons. Even with allowance for the big increase in the production of petroleum and the substitution of fuel oil for coal, it is apparent that the normal growth in the world's consumption of energy has been retarded by the war.

A feature of the changes brought by the war was a shift in the relative importance of the principal producing countries. The leadership of the United States became even more apparent as the production of Europe gradually declined. From 38.6 per cent of the world's total in 1913, the share of the United States rose to 46.3 per cent in 1918, and even in 1923 it was nearly 44 per cent.

The great event of the year 1923, however, was the occupation of the Ruhr by the French and Belgians and the consequent paralysis of the chief source of German production. From 129,964,000 tons in 1922 the output of bituminous coal in Germany dropped to 62,316,000 tons in 1923. The output of lignite, though less affected by the occupation, also declined. The stoppage of shipments from the Ruhr greatly increased the demand for coal from other sources. The output of Great Britain, in particular, was stimulated and rose to 280,430,000 metric tons, an increase of nearly 30,000,000 tons over 1922 and the largest figure recorded since the war began.

The following table has been compiled from the official reports of the several countries, supplemented by trade information, by W. I. Whiteside, under the direction of B. L. Johnson. The unit of measurement is the metric ton of 2,204.6 pounds, which can best be remembered by the American reader as roughly equivalent to the long or gross ton. The term "coal" as used by the Geological Survey includes lignite, and the production for the world is simply the total of the quantities reported, no attempt being made to reduce the statistics for inferior coals to an equivalent tonnage of coals of higher rank. Where possible, however, lignite is shown separately.

TABLE 76.—*World's production of coal, 1910–1923*

Year	Production, in part estimated (metric tons)	Percentage produced by United States	Year	Production, in part estimated (metric tons)	Percentage produced by United States
1910	1,160,000,000	39.2	1917	1,356,000,000	43.6
1911	1,189,000,000	37.9	1918	1,333,000,000	46.3
1912	1,249,000,000	38.8	1919	1,173,000,000	42.8
1913	1,342,000,000	38.6	1920	1,320,000,000	45.3
1914	1,207,000,000	38.7	1921	1,135,000,000	40.5
1915	1,193,000,000	40.5	1922	1,225,000,000	35.3
1916	1,291,000,000	41.5	1923	1,360,000,000	43.9

TABLE 77.—*Coal produced in the principal countries of the world, 1920–1923*

[In metric tons of 2,204.6 pounds]

Country	1920	1921	1922	1923
North America:				
Canada: Coal	12,020,531	10,684,259	10,587,611	12,163,804
Lignite	3,353,234	2,975,598	3,162,907	3,249,605
Greenland	2,308	2,200	2,100	2,117
Mexico	715,789	734,980	932,550	1,261,541
United States: Anthracite	81,282,000	82,076,000	49,607,344	84,675,282
Bituminous and lignite	515,883,000	377,316,000	383,073,174	512,161,770
South America:				
Argentina	(a)	(a)	(a)	(a)
Brazil	(a)	(a)	500,000	324,154
Chile	1,063,185	1,275,117	1,053,001	1,164,028
Colombia	(a)	(a)	(a)	(a)
Peru	361,075	345,481	294,492	[b] 253,000
Venezuela	30,377	[c] 22,094	[c] 20,782	[c] 13,050
Europe:				
Austria: Coal	132,864	137,633	165,727	157,650
Lignite	2,408,865	2,478,862	3,135,902	2,685,467
Belgium	22,388,770	21,750,410	21,208,500	22,922,340
Bulgaria	757,250	939,586	1,030,036	1,074,194
Czechoslovakia: Coal	11,374,954	12,023,209	10,464,990	12,347,251
Lignite	20,156,610	21,335,128	19,174,296	16,265,530
France: Coal	24,293,223	28,211,839	31,141,096	37,682,235
Lignite	967,835	748,634	772,014	861,435
Germany: Coal	131,355,964	136,251,363	[d] 129,964,597	62,316,134
Lignite	111,887,694	123,063,811	137,207,125	118,784,997
Saar	9,410,433	9,574,602	11,240,000	9,192,275
Greece: Lignite	197,454	168,576	131,515	126,000
Hungary	4,963,060	6,417,960	7,717,610	7,709,775
Italy: Coal	151,862	114,236	195,352	173,700
Lignite	1,571,735	1,026,035	745,402	953,460
Netherlands: Coal	4,115,629	4,243,000	4,866,371	5,595,478
Lignite	1,395,851	121,715	28,919	54,185
Poland	6,660,145	7,842,553	[e] 24,194,797	36,269,032
Portugal	169,165	135,732	141,659	153,565
Rumania	1,587,575	1,804,687	2,116,221	2,521,393
Russia	6,067,300	7,550,800	7,781,400	[f] 14,504,300
Spain: Coal	5,420,704	5,012,229	4,435,843	5,971,446
Lignite	552,425	408,674	329,680	394,268
Spitsbergen	130,000	210,000	316,000	340,942
Sweden	439,584	376,692	378,861	419,569
Switzerland	74,590	10,714	3,380	(a)
United Kingdom:				
Great Britain	233,106,377	165,781,404	253,613,054	280,430,369
Ireland	109,845	89,958	(a)	(a)
Yugoslavia	3,412,361	3,063,198	3,726,568	4,001,265
Asia:				
China	19,484,896	19,876,375	22,681,000	19,955,000
Chosen	293,675	310,590	317,330	279,978
Federated Malay States	251,896	304,156	286,351	322,994
India, British	18,250,508	19,612,759	19,316,112	19,973,285
Indo-China	700,267	920,900	988,991	1,056,921
Japan (including Taiwan and Karafuto)[g]	30,550,625	27,413,517	29,163,727	30,417,012
Russia	1,544,600	1,363,800	1,276,900	(f)
Turkey	[h] 700,000	(a)	[h] 681,000	(a)
Africa:				
Algeria	7,793	9,541	8,855	3,562
Belgian Congo	2,000	2,990	33,000	65,000
Nigeria	183,013	216,262	123,027	173,422
Rhodesia, Southern	524,796	521,404	467,787	560,000
Tunisia: Lignite	31,331	22,207	343	620
Union of South Africa	10,408,497	10,339,044	8,830,774	10,810,897
Oceania:				
Australia:				
New South Wales	10,887,991	10,966,621	10,346,572	10,646,693
Queensland	1,127,727	970,087	973,903	1,077,686
Tasmania	76,640	67,543	70,349	82,014
Victoria	614,632	603,618	660,113	603,240
Western Australia	469,436	476,341	445,480	427,466
British Borneo	(a)	(a)	88,948	(a)
Dutch East Indies	1,095,718	1,212,665	1,032,310	1,156,625
New Zealand	1,873,296	1,838,131	1,887,637	2,001,450
Philippine Islands	58,888	39,445	(a)	(a)
	1,319,700,000	1,134,600,000	1,225,500,000	1,359,900,000

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[a] Estimate included in total.

[b] Includes small quantity of asphaltite.

[c] Exclusive of output of State of Falcón (about 8,000 tons), for which estimate is included in total.

[d] Includes for January to May entire output of Upper Silesia, for June to December output of only that part of the province allocated to Germany.

[e] Includes output for June to December of that part of Upper Silesia allocated to Poland.

[f] Output of Russia in Asia included with Russia in Europe.

[g] Exclusive of lignite (annual production about 200,000 tons), for which estimate is included in total.

[h] Based on incomplete data.

PRODUCTION OF COAL BY STATES

FORM OF PRESENTATION

In the foregoing pages are presented the general statistical facts of 1923 for the coal industry as a whole. It remains to give the detailed figures of production by States and counties.

As the detailed statistics are useful chiefly for reference, they require no extended comment. The figures for a given area, however, can be used more intelligently if they are considered in the light of the market conditions prevailing in that area for the year. For this purpose a series of charts are interspersed with the tables showing for most of the States the trend of production in each month of 1923 and how it compares with the level of the five years preceding.

The form of these charts will be clear from a glance at the one for Alabama (fig. 45). It will be seen that the background of the chart is divided into two blocks. The larger block, at the right, covers 1923. The smaller block, at the left, covers the five years 1918 to 1922. To show so long a period it is necessary to make a change in the time scale, and so in the 1923 block each division represents a month, while in the five-year block each division represents the average for a year. Now, to compare periods of unlike length some common denominator is necessary, and the best one to use is the average output per working day. By this means it is a simple matter to compare not only years with months, but also short months like February, which would otherwise show an artificial downward jag, with long months like March. Thus the heavy black line of daily production starts at an average of 62,000 tons in the war year 1918, drops to 50,000 tons in 1919, recovers slightly in 1920, falls to 41,000 in the depression year 1921, and in 1922, when the strike closed the union mines, rises to 60,000 tons. In January, 1923, the daily average was running 72,300 tons, or considerably above the general level of any of the five years preceding. This high rate was maintained without a break until December.

The Alabama chart also shows the trend of spot prices of mine-run coal f. o. b. mines as quoted by Coal Age. Prices are represented by the light dash line. The average price for the year 1919 as a whole (quotations for 1918 are not available) was $2.64; for 1920, as a whole, the average was $5.12, though during certain months of that year much higher prices were touched. In 1921 prices dropped to the level of 1919, and in 1922 they receded still further. In 1923 the line of price starts at $2.40 in January, rises slightly in February, and declines gradually thereafter to $1.90 in the last four months of the year.

The charts for the other States are drawn in the same way but with a certain exception. Because Pennsylvania's output is so much greater than Maryland's, for example, it is not feasible to plot them on the same scale. Hence, one scale has been used for the large States—Alabama, Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia—and a different scale for the remaining smaller States. The scale for the small States is about seven times that for the large States, and to warn the reader of the difference the scale used is conspicuously posted in the upper right corner of each diagram.

In Tables 78 and 79 are given the figures of average daily production and spot prices plotted in this series of charts.

TABLE 78.—*Estimated average daily output of bituminous coal, by States, in each month of 1923*

[The figures represent the average per working day. The total number of working days in 1923, for the country as a whole, was 306]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
Alabama	72, 300	68, 200	70, 500	68, 700	66, 400	64, 500	64, 800	66, 200	67, 600	66, 400	68, 200	58, 200	66, 900
Arkansas	5, 100	4, 200	3, 700	3, 500	3, 300	3, 700	4, 200	4, 400	5, 200	4, 700	4, 700	4, 200	4, 200
Colorado	37, 700	38, 500	32, 600	30, 700	28, 000	29, 200	27, 600	28, 800	35, 600	36, 200	39, 300	42, 200	33, 800
Illinois	351, 900	332, 100	280, 600	245, 200	215, 400	207, 200	211, 400	227, 100	264, 400	259, 800	261, 900	255, 800	259, 200
Indiana	109, 900	102, 100	95, 800	85, 600	65, 600	69, 300	75, 100	73, 300	91, 600	86, 600	89, 300	85, 700	85, 700
Iowa	23, 300	22, 700	20, 400	16, 600	14, 900	14, 700	14, 600	16, 700	19, 500	19, 400	21, 400	20, 200	18, 700
Kansas	17, 100	15, 800	14, 000	13, 100	12, 500	12, 200	12, 700	14, 000	15, 800	15, 200	17, 000	15, 000	14, 500
Kentucky	141, 200	130, 500	129, 200	134, 600	143, 600	140, 700	156, 100	163, 600	160, 200	167, 100	157, 000	131, 300	146, 300
Maryland	9, 100	8, 500	8, 700	8, 700	7, 900	7, 800	7, 000	7, 400	6, 700	5, 900	5, 900	6, 100	7, 500
Michigan	5, 400	4, 400	5, 300	3, 700	2, 000	2, 000	2, 800	3, 500	4, 500	4, 700	4, 300	3, 400	3, 800
Missouri	14, 500	13, 200	10, 000	9, 800	9, 400	9, 100	9, 700	10, 200	12, 200	11, 700	12, 200	11, 500	11, 100
Montana	13, 700	13, 300	11, 400	7, 000	7, 100	6, 300	6, 800	8, 300	11, 300	13, 700	13, 900	10, 600	10, 300
New Mexico	12, 100	9, 700	8, 900	9, 900	9, 600	8, 500	8, 700	8, 200	9, 400	9, 600	10, 300	9, 400	9, 500
North Dakota	8, 400	6, 200	5, 700	2, 600	2, 400	2, 300	2, 400	3, 400	4, 500	6, 000	5, 800	4, 500	4, 500
Ohio	135, 600	115, 600	123, 300	127, 600	143, 400	148, 000	142, 400	145, 100	143, 500	136, 100	127, 300	99, 800	132, 500
Oklahoma	10, 300	10, 300	9, 200	8, 200	7, 600	8, 000	8, 100	9, 200	10, 800	10, 100	12, 000	9, 700	9, 400
Pennsylvania	567, 000	514, 600	541, 500	588, 400	596, 400	602, 200	613, 300	622, 400	597, 400	524, 800	498, 900	469, 600	561, 700
Tennessee	22, 200	21, 100	19, 700	20, 100	20, 100	18, 900	18, 800	19, 700	19, 900	19, 600	19, 600	17, 100	19, 800
Texas	4, 300	3, 900	3, 200	3, 300	3, 600	3, 500	3, 900	4, 000	4, 300	4, 300	4, 800	3, 500	3, 900
Utah	18, 200	16, 000	11, 300	11, 600	12, 300	14, 800	14, 500	13, 900	17, 200	20, 200	18, 700	16, 600	15, 400
Virginia	35, 200	35, 400	38, 300	41, 500	41, 700	39, 900	39, 900	41, 400	40, 800	38, 500	36, 200	32, 100	38, 400
Washington	12, 400	12, 800	12, 300	5, 900	7, 300	7, 400	6, 100	7, 800	9, 700	11, 300	12, 000	9, 500	9, 600
West Virginia	316, 000	300, 000	314, 900	339, 000	373, 600	372, 600	397, 500	398, 300	388, 500	382, 200	341, 200	304, 000	352, 600
Wyoming	31, 100	26, 000	22, 600	19, 300	18, 400	17, 400	19, 100	25, 600	27, 500	30, 700	30, 600	28, 900	24, 800
Other States[a]	1, 100	1, 100	1, 200	1, 000	800	800	700	600	600	600	800	800	900
	1, 975, 000	1, 826, 000	1, 794, 000	1, 806, 000	1, 813, 000	1, 811, 000	1, 868, 000	1, 923, 000	1, 969, 000	1, 885, 000	1, 813, 000	1, 650, 000	1, 845, 000

[a] Alaska, California, Georgia, Idaho, North Carolina, Oregon, and South Dakota.

TABLE 79.—*Average spot prices of bituminous coal f. o. b. mines in certain States, 1918–1923, as published in Coal Age*

State	Annual average					Monthly averages in 1923											
	1918	1919	1920	1921	1922	January	February	March	April	May	June	July	August	September	October	November	December
Alabama:																	
Steam coal, run-of-mine	([a])	$2.64	$5.12	$2.63	$2.42	$2.40	$2.50	$2.15	$2.15	$2.05	$2.05	$2.00	$1.95	$1.90	$1.90	$1.90	$1.90
Illinois:																	
Central, run-of-mine	$2.29	2.31	4.23	2.36	3.14	3.18	2.69	2.63	2.23	2.13	2.13	2.13	2.16	2.23	2.13	2.13	2.13
Southern, run-of-mine	2.31	2.42	4.18	3.01	3.55	3.98	3.64	3.32	3.13	3.13	3.13	2.98	2.91	3.00	2.73	2.54	2.38
Standard, run-of-mine	2.27	2.02	3.94	1.90	2.53	2.56	2.25	2.22	1.93	1.84	1.81	1.83	1.85	2.01	2.06	2.06	2.00
Indiana, 4th and 5th vein:																	
Lump	([a])	2.71	4.52	3.09	4.00	4.70	4.06	3.57	3.13	3.13	3.13	3.13	3.10	3.06	2.94	2.94	2.87
Mine run	2.28	2.45	3.98	2.63	3.33	3.54	2.94	2.66	2.50	2.50	2.36	2.38	2.38	2.38	2.38	2.33	2.38
Screenings	([a])	2.09	3.68	1.83	2.66	2.27	2.15	1.84	1.71	1.75	1.68	1.54	1.51	1.42	1.06	1.06	1.57
Kentucky:																	
Eastern, run-of-mine	2.89	2.80	6.21	2.47	3.46	3.51	2.76	2.76	2.67	2.39	2.09	1.92	1.75	1.92	1.87	1.85	1.71
Western, run-of-mine	2.20	2.30	4.22	2.24	3.25	2.57	2.25	2.00	2.00	1.90	1.76	1.69	1.76	1.96	1.76	1.72	1.72
Ohio:																	
Pittsburgh, No. 8, run-of-mine	2.44	2.22	5.82	2.28	3.57	3.49	3.42	2.76	2.22	2.17	1.98	1.92	2.04	2.09	1.90	1.90	1.91
Hocking, run-of-mine	2.51	2.29	4.67	2.17	3.32	3.02	2.63	2.48	2.14	1.97	1.89	1.88	1.88	1.93	1.90	1.88	1.70
Pennsylvania:																	
Somerset, run-of-mine	2.84	3.08	6.60	2.64	3.51	5.21	4.04	3.47	3.29	2.87	2.79	2.60	2.60	2.44	2.33	2.36	2.14
Clearfield, run-of-mine	2.84	2.62	6.96	2.24	3.59	4.85	3.85	3.13	2.86	2.56	2.44	2.35	2.34	2.18	2.07	2.10	1.88
Pittsburgh, run-of-mine	2.36	2.11	5.72	2.25	2.78	3.43	2.85	2.52	2.00	2.06	2.13	1.97	2.11	2.25	1.92	1.95	2.02
West Virginia:																	
Smokeless, run-of-mine	2.42	2.93	7.23	2.52	3.52	5.95	4.60	4.24	3.85	3.98	3.79	3.25	2.91	2.90	2.59	2.13	1.97
Kanawha, run-of-mine	2.53	2.78	5.06	2.20	3.42	3.52	2.82	2.93	2.46	2.12	1.90	1.80	1.78	1.87	1.73	1.69	1.63

[a] No data.

ALABAMA

The production of coal in Alabama in 1923 was the greatest recorded in the history of the State, exceeding that of the previous banner year, 1917, by 389,575 tons. The total output for the year was 20,457,649 tons, valued at $51,624,000, an increase over 1922 of 2,132,909 tons, or 11.6 per cent, in quantity and of $8,768,000, or 20.5 per cent, in value. Jefferson County contributed most of the gain.

The number of days worked increased from 215 to 232, the highest average among all the important coal-producing States; and, as shown in Figure 45, the number of tons produced per working day in each month in 1923, with little variation, was greater than the average for any of the preceding five years till December, when it fell below that for 1918 and 1922. In 1918 this daily average was 62,000 tons, in 1922 it was 60,000 tons, and in December, 1923, it was 58,000 tons.

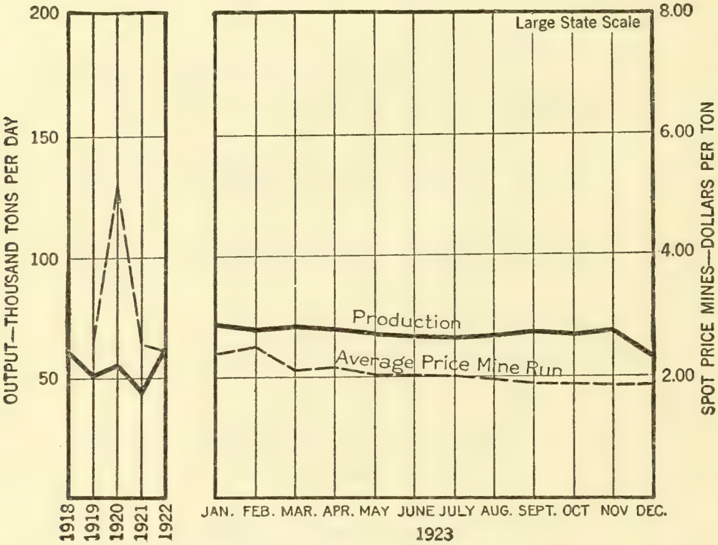

FIGURE 45.—Production of coal per working day and trend of spot prices in Alabama, 1918–1923. Data from Tables 78 and 79; spot prices as quoted by Coal Age

In 1919 the average spot price quoted by Coal Age for Alabama coal was $2.64; in 1920 it was almost double that—$5.12; since 1921 the curve of price has followed a uniformly downward course, except for a slight rise in February, 1923.

TABLE 80.—*Coal produced in Alabama, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1922												
Bibb	1,014,072	5,259	20,358		1,039,689	$2,591,000	$2.49	1,106	482	321	1,909	203
Blount	313,767	1,930	5,263		320,960	807,000	2.51	463	70	115	648	176
Etowah	95,042	2,319	1,449		98,810	227,000	2.30	166	20	33	219	228
Jefferson	7,790,054	109,907	161,470	123,436	8,184,867	18,866,600	2.31	6,568	3,297	1,845	11,710	229
St. Clair	779,952	4,310	19,035		803,297	1,898,000	2.36	616	175	131	922	252
Shelby	596,334	12,297	18,510		627,141	1,901,000	3.03	882	334	238	1,454	205
Tuscaloosa	966,227	19,952	16,339	174,246	1,176,764	2,271,000	1.93	984	362	234	1,580	259
Walker	5,553,635	201,742	41,902		5,797,279	13,502,000	2.33	5,539	1,710	2,021	9,270	195
Winston	27,795	585			28,380	79,000	2.79	75	23	21	119	124
Other counties [b]	142,882	2,510	5,861		151,253	426,400	2.82	216	55	67	338	169
Total, excluding wagon mines	[c] 17,279,760	360,811	290,187	297,682	18,228,440	42,569,000	2.34	16,615	6,528	5,026	28,169	215
Wagon mines served by rail	96,300				96,300	287,000	2.98					
Grand total	17,376,060	360,811	290,187	297,682	18,324,740	42,856,000	2.34					
1923												
Bibb	1,192,795	5,338	28,938		1,227,071	3,345,000	2.73	1,174	498	392	2,064	207
Blount	257,007	1,508	5,000		263,515	667,000	2.53	358	57	99	514	165
Etowah	128,118	1,864	2,173		132,155	366,000	2.77	161	25	50	236	302
Jefferson	9,410,779	113,367	170,221	55,502	9,749,869	24,562,000	2.52	7,338	3,921	2,288	13,547	254
St. Clair	772,016	4,617	26,648		803,281	1,984,000	2.47	503	206	85	794	271
Shelby	660,113	4,990	11,374		676,477	2,198,000	3.25	872	339	234	1,445	201
Tuscaloosa	974,009	22,577	17,238	203,403	1,217,227	2,742,000	2.25	1,028	423	294	1,745	258
Walker	5,898,200	211,965	38,903		6,149,068	15,011,000	2.44	5,619	1,781	1,894	9,294	205
Winston	19,736	2,100			21,836	66,000	3.02	44	15	15	74	112
Other counties [d]	[c] 169,851	2,428	6,861		179,140	598,000	3.34	207	65	50	322	215
Total, excluding wagon mines	19,482,624	370,754	307,356	258.905	20,419,639	51,539,000	2.52	17,304	7,330	5,401	30,035	232
Wagon mines served by rail	38,010				38,010	85,000	2.23					
Grand total	19,520,634	370,754	307,356	258,905	20,457,649	51,624,000	2.52					

[a] Includes also loaders and shot firers.
[b] Cullman, Franklin, and Marion.
[c] Includes coal for by-product coke ovens transported over private railroads.
[d] Franklin and Marion.

TABLE 81.—*Coal produced in Alabama, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Bibb	1, 034, 099	968, 011	643, 992	1, 039, 689	1, 227, 071	+187, 382
Blount	283, 606	285, 384	302, 390	320, 960	263, 515	−57, 445
Cullman and Marion	119, 390	121, 886	84, 791	[a] 151, 253	[a] 179, 140	+27, 887
Etowah	91, 397	76, 568	75, 107	98, 810	132, 155	+33, 345
Jefferson	7, 548, 567	7, 719, 910	5, 864, 475	8, 184, 867	9, 749, 869	+1, 565, 002
St. Clair	668, 304	662, 209	646, 212	803, 297	803, 281	−16
Shelby	562, 863	586, 996	460, 496	627, 141	676, 477	+49, 336
Tuscaloosa	872, 778	914, 183	538, 402	1, 176, 764	1, 217, 227	+40, 463
Walker	4, 290, 298	4, 768, 457	3, 919, 884	5, 797, 279	6, 149, 068	+351, 789
Winston	65, 006	36, 495	33, 150	28, 380	21, 836	−6, 544
Small mines	413	154, 000	([b])	96, 300	38, 010	−58, 290
	15, 536, 721	16, 294, 099	12, 568, 899	18, 324, 740	20, 457, 649	+2, 132, 909
Total value	$45, 937, 681	$59, 410, 000	$38, 713, 000	$42, 856, 000	$51, 624, 000	+$8, 768, 000

[a] Includes Franklin in 1922 and 1923; no production in Cullman in 1923.
[b] No canvass of wagon mines for 1921.

ALASKA

In 1923 Alaska produced 119,826 tons of coal, valued at $755,000. This tonnage came from 12 mines, the largest of which were the Evan Jones mine, in the Matanuska field, and the Healy River mine, in the Nenana field, both served by the Alaska Railroad. These 12 mines employed altogether 199 men and were in operation on an average of 220 days. The output in 1923 was 40,551 tons, or 51.2 per cent, greater than in 1922, and it is significant that the Territory is supplying more and more of its own fuel.

The Alaskan branch of the Geological Survey has revised the coal figures for the years 1880 to 1919, but this revision is comparatively so slight that it has not been considered necessary to change the United States totals for these years. The revised table is, however, given on the following page.

Table 82.—*Coal produced and consumed in Alaska, 1880–1923*

Year	Produced in Alaska, chiefly subbituminous and lignite [a]		Imported from States, chiefly bituminous coal from Washington (net tons)	Total foreign coal, chiefly bituminous coal from British Columbia (net tons)	Total coal consumed (net tons)
	Net tons	Value			
1880–1890	6,076	$37,205	([b])	([b])	([b])
1891	1,083	6,291			
1892	871	5,093			
1893	923	5,372			
1894	488	2,765			
1895	1,687	9,290			
1896	712	4,142			
1897	2,673	31,393			
1898	2,652	27,201			
1899	2,264	22,836	10,000	[c] 50,120	62,384
1900	2,855	35,275	15,048	[c] 56,623	74,526
1901	2,740	29,843	24,000	[c] 77,674	104,414
1902	3,052	22,508	40,000	[c] 68,363	111,415
1903	2,717	21,302	64,626	[c] 60,605	127,948
1904	1,824	8,195	36,689	[c] 76,815	115,328
1905	4,334	15,070	67,713	[c] 72,612	144,659
1906	6,061	19,924	69,493	[c] 47,590	123,144
1907	10,689	55,770	46,246	[c] 93,262	150,197
1908	4,066	22,665	23,893	[c] 86,404	114,363
1909	3,430	16,350	33,112	69,046	105,588
1910	2,250	13,200	32,098	58,420	92,768
1911	1,850	11,690	32,255	61,845	95,950
1912	1,205	7,130	27,767	68,316	97,288
1913	2,312	13,290	69,066	56,430	127,808
1914	1,190	6,540	41,509	46,153	88,852
1915	1,629	6,653	46,329	29,457	77,415
1916	12,676	57,412	44,934	53,672	111,282
1917	54,275	268,438	58,116	56,589	168,980
1918	75,816	413,870	51,520	37,986	165,322
1919	60,894	345,617	57,166	48,708	166,768
1920	61,111	355,668	38,128	45,264	144,503
1921	76,817	496,394	24,278	33,776	134,871
1922	79,275	430,639	28,457	34,251	141,983
1923	119,826	755,469	34,082	43,205	197,113
	612,323	3,580,500	1,016,525	1,433,186	3,044,869

[a] Figures for 1880–1919 are as revised by the Alaskan branch of the Geological Survey.
[b] No figures on imports before 1899 are available.
[c] For fiscal year ending June 30.

ARKANSAS

In 1923 the production of coal in Arkansas was 1,296,892 tons, valued at $5,192,000, which was an increase of 186,846 tons, or 16.8 per cent, in quantity, and of $600,000, or 13.1 per cent, in value over that of 1922. The average value per ton, however, was $4.01—lower than that of the preceding year, which was $4.14. Although the number of days worked increased from 81 to 97, Arkansas still ranked the lowest of all the States in the actual days the mines were in operation.

Figure 49 compares the production per day in each month of 1923 with the daily average for the years 1918 to 1922. Against a maximum of 7,000 tons a day in 1918 and a minimum of 3,600 tons in the strike year 1922, the daily production in 1923 ranged from 5,000 tons in January and September to 3,000 tons in May.

TABLE 83.—*Coal produced in Arkansas, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
							Underground				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Miners [a]	All others	Surface	Total	
1922											
Franklin	161, 232	1, 557	5, 865	168, 654	$641, 000	$3. 80	314	97	140	551	80
Johnson	125, 478	3, 528	3, 325	132, 331	638, 000	4. 82	341	153	197	691	65
Logan	57, 212	1, 580	1, 069	59, 861	418, 000	6. 98	231	87	34	352	113
Sebastian	671, 897	5, 372	15, 332	692, 601	2, 521, 000	3. 64	1, 379	604	285	2, 268	81
Other counties [b]	26, 932	3, 075	2, 592	32, 599	270, 000	8. 28	121	32	20	173	93
Total, excluding wagon mines	1, 042, 751	15, 112	28, 183	1, 086, 046	4, 488, 000	4. 13	2, 386	973	676	4, 035	81
Wagon mines served by rail	24, 000			24, 000	104, 000	4. 35					
Grand total	1, 066, 751	15, 112	28, 183	1, 110, 046	4, 592, 000	4. 14					
1923											
Franklin	246, 487	1, 791	5, 763	254, 041	845, 000	3. 33	272	99	241	612	105
Johnson	174, 110	1, 542	4, 139	179, 791	898, 000	4. 99	330	170	235	735	78
Logan	79, 535	3, 820	1, 171	84, 526	521, 000	6. 16	248	83	44	375	104
Sebastian	620, 960	1, 583	20, 174	642, 717	2, 197, 000	3. 42	1, 180	456	243	1, 879	94
Other counties [b]	60, 608	4, 109	7, 450	72, 167	524, 000	7. 26	94	38	21	153	189
Total, excluding wagon mines	1, 181, 700	12, 845	38, 697	1, 233, 242	4, 985, 000	4. 04	2, 124	846	784	3, 754	97
Wagon mines served by rail	63, 650			63, 650	207, 000	3. 26					
Grand total	1, 245, 350	12, 845	38, 697	1, 296, 892	5, 192, 000	4. 01					

[a] Includes also loaders and shot firers.

[b] Pope, Scott, and Washington.

TABLE 84.—*Coal produced in Arkansas, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Franklin	144, 541	278, 450	164, 046	168, 654	254, 041	+85, 387
Johnson	211, 036	257, 517	58, 792	132, 331	179, 791	+47, 460
Logan	42, 937	66, 636	74, 962	59, 861	84, 526	+24, 665
Pope, Scott, and Washington	[a] 118, 061	126, 528	[a] 103, 156	32, 599	72, 167	+39, 568
Sebastian	903, 414	1, 321, 465	826, 821	692, 601	642, 717	−49, 884
Small mines	9, 031	53, 000	([b])	24, 000	63, 650	+39, 650
	1, 429, 020	2, 103, 596	1, 227, 777	1, 110, 046	1, 296, 892	+186, 846
Total value	$5, 288, 844	$9, 592, 000	$5, 360, 000	$4, 592, 000	$5, 192, 000	+$600, 000

[a] No production in Washington in 1919; no production in Scott in 1921.
[b] No canvass of wagon mines for 1921.

CALIFORNIA, IDAHO, NEVADA, AND OREGON

For years the coal producers in California, Idaho, Nevada, and Oregon have been so few that it has been necessary to group them to avoid disclosing individual operations. Since 1915 no production has been recorded for Nevada. The following table shows the totals for these States from 1912 to 1923:

TABLE 85.—*Coal produced in California, 1912–13; in California, Idaho, and Nevada, 1914–15; in California and Idaho, 1916–1920; in California, Idaho, and Oregon, 1921–1923*

Year	Net tons				Value		Number of employees	Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton		
1912	3, 748	3, 630	3, 600	10, 978	$23, 601	$2. 15	52	184
1913	14, 864	1, 808	8, 167	24, 839	84, 073	3. 38	35	332
1914	4, 200	9, 174	600	13, 974	39, 821	2. 85	43	291
1915	2, 488	9, 715	300	12, 503	32, 054	2. 56	36	285
1916	1, 593	4, 647	1, 000	7, 240	15, 367	2. 12	18	188
1917	2, 800	3, 383	240	6, 423	14, 791	2. 30	17	173
1918	5, 800	600	----------	6, 400	17, 250	2. 70	15	240
1919	2, 448	3, 591	515	6, 554	22, 174	3. 38	77	59
1920	208	2, 540	5	2, 753	12, 000	4. 23	10	181
1921	19, 015	13, 305	6, 525	38, 845	181, 000	4. 66	141	149
1922	17, 011	3, 662	6, 220	26, 893	104, 000	3. 87	60	250
1923	11, 256	1, 555	7, 255	20, 066	79, 000	3. 94	93	206

COLORADO

Although in 1923 Colorado showed an increase in tonnage over 1922, it did not equal that of several other years in the history of the State. The output was 10,346,218 tons, valued at $33,299,000, and the increase was 326,621 tons, or 3.3 per cent, in quantity, and $1,598,000, or 5 per cent, in value; but the average number of employees and of actual days worked during the year decreased slightly. The number of days worked in 1923 is affected by a peculiarity in the returns for Routt County, which is explained in footnote [b], Table 86, page 658.

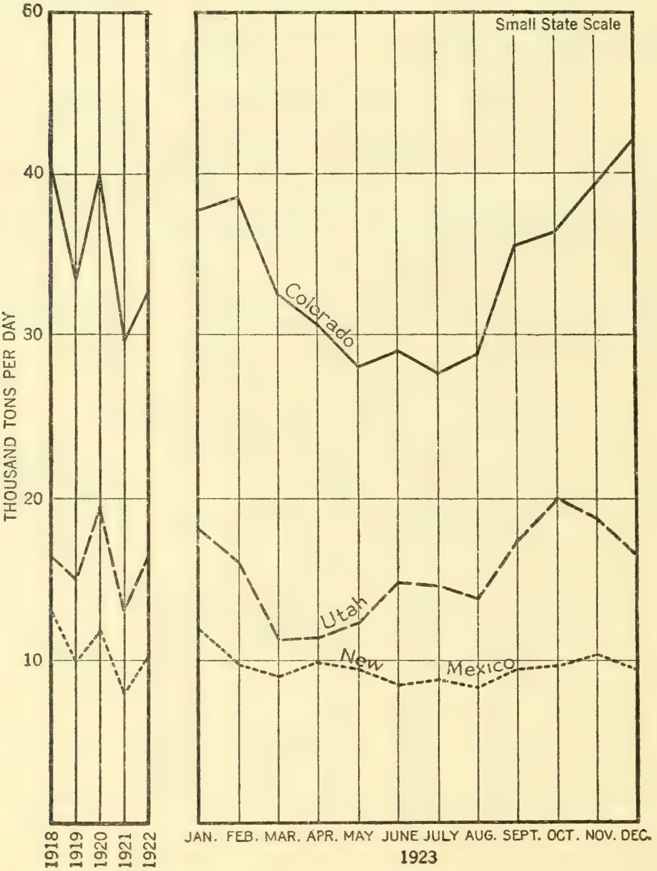

FIGURE 46.—Production of coal per working day in Colorado, Utah, and New Mexico, 1918-1923. Data from Table 78

Figure 46 makes clear the fluctuations in the quantity produced per working day in the years 1918 to 1922 and the months of 1923. The seasonal character of the demand for the domestic coals and lignite of Colorado introduces a characteristic summer trough and winter peak into the curve of production for the State as a whole, in sharp contrast to the relatively steady curve for New Mexico, the output of which goes more largely for industrial use.

TABLE 86.—*Coal produced in Colorado, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1922												
Boulder	644, 461	48, 974	35, 508		728, 943	$2, 180, 000	$2. 95	698	266	232	1, 196	167
Delta	80, 447	24, 726	30		105, 203	339, 000	3. 19	77	19	25	121	143
Elbert, Jackson, and Pitkin	59, 107	5, 482	1, 503		66, 092	245, 000	3. 71	43	15	22	80	183
El Paso	219, 668	158, 167	11, 568		389, 403	1, 068, 000	2. 74	242	75	71	388	226
Fremont	388, 310	79, 430	10, 462		478, 202	2, 043, 000	4. 27	615	248	135	998	167
Garfield	10, 129	9, 549	100		19, 778	66, 000	3. 34	16	3	4	23	234
Gunnison	405, 463	5, 348	26, 711		437, 522	1, 334, 000	3. 05	255	128	124	507	196
Huerfano	2, 026, 743	28, 104	14, 503		2, 069, 350	7, 536, 000	3. 64	1, 437	620	496	2, 553	224
Jefferson	169, 430	3, 257	7, 860		180, 547	412, 000	2. 29	100	48	25	173	265
La Plata	45, 511	21, 673	239	11, 663	79, 086	225, 000	2. 85	118	39	33	190	132
Las Animas	3, 174, 875	47, 929	59, 044	88, 216	3, 370, 064	10, 222, 000	3. 03	2, 741	1, 028	721	4, 490	212
Mesa	120, 762	31, 175			151, 937	498, 000	3. 28	153	45	51	249	197
Moffat	1, 500	3, 375			4, 875	10, 000	2. 07	8	6	4	18	93
Montezuma and Ouray		4, 002			4, 002	19, 000	4. 75	12			12	209
Rio Blanco		3, 349			3, 349	11, 000	3. 28	9	2	2	13	166
Routt	383, 887	11, 715	36, 596		432, 198	1, 657, 000	3. 83	527	230	250	1, 007	[b]51
Weld	1, 389, 252	56, 528	28, 131		1, 473, 911	3, 738, 000	2. 54	860	386	242	1, 488	196
Total, excluding wagon mines	9, 119, 545	542, 783	232, 255	99, 879	9, 994, 462	31, 603, 000	3. 16	7, 911	3, 158	2, 437	13, 506	191
Wagon mines served by rail	25, 135				25, 135	98, 000	3. 90					
Grand total	9, 144, 680	542, 783	232, 255	99, 879	10, 019, 597	31, 701, 000	3. 16					

[a] Includes also loaders and shot firers.

[b] See note [b], page 658.

TABLE 86.—*Coal produced in Colorado, 1922–23*—Continued

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1923												
Archuleta, Moffat, Montezuma, Montrose, and Pitkin	2, 091	9, 939	100		12, 130	$38, 000	$3. 22	21	3	3	27	171
Boulder	556, 035	36, 149	35, 818		628, 002	1, 690, 000	2. 69	538	224	126	888	155
Delta	79, 966	27, 239	395		107, 600	342, 000	3. 18	70	16	27	113	165
Elbert and Jefferson	140, 514	6, 783	9, 490		156, 787	346, 000	2. 21	106	53	28	187	211
El Paso	196, 438	147, 030	12, 115		355, 583	1, 030, 000	2. 90	234	86	55	375	185
Fremont	526, 335	80, 670	6, 458		613, 463	2, 658, 000	4. 33	649	284	158	1, 091	164
Garfield	202	22, 138			22, 340	80, 000	3. 54	31	4	2	37	163
Gunnison	509, 659	7, 409	25, 924		542, 992	1, 835, 000	3. 38	363	137	153	653	182
Huerfano	1, 928, 472	20, 727	16, 218		1, 965, 417	7, 319, 000	3. 72	1, 442	571	452	2, 465	175
Jackson	55, 500	1, 660	100		57, 260	121, 000	2. 11	46	11	19	76	266
La Plata	68, 577	27, 860	28	14, 292	110, 757	341, 000	3. 08	99	30	16	145	223
Las Animas	2, 900, 287	57, 477	55, 995	175, 743	3, 189, 502	10, 245, 000	3. 21	2, 797	956	653	4, 406	184
Mesa	148, 344	30, 025	2, 205		180, 574	510, 000	2. 82	188	55	37	280	195
Rio Blanco		3, 706			3, 706	13, 000	3. 78	5	1		6	240
Routt	745, 508	16, 099	41, 848		803, 455	3, 120, 000	3. 88	592	218	248	1, 058	[b] 57
Weld	1, 512, 976	39, 553	24, 901		1, 577, 430	3, 555, 000	2. 25	883	465	185	1, 533	193
Total, excluding wagon mines	9, 370, 904	534, 464	231, 595	190, 035	10, 326, 998	33, 243, 000	3. 22	8, 064	3, 114	2, 162	13, 340	174
Wagon mines served by rail	19, 220				19, 220	56, 000	2. 92					
Grand total	9, 390, 124	534, 464	231, 595	190, 035	10, 346, 218	33, 299, 000	3. 22					

[a] Includes also loaders and shot firers.

[b] In Routt County the mines have in recent times followed the practice of reducing their forces in periods of dull market and of working every day underground when the tipple works only one, two, or three days a week. As the figure of days worked represents tipple time, the result is not comparable with the returns for other counties, and the average for the State is affected also.

TABLE 87.—*Coal produced in Colorado, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Boulder	1,122,485	1,218,504	851,686	728,943	628,002	−100,941
Delta	90,301	120,899	89,935	105,203	107,600	+2,397
El Paso	306,039	383,977	288,531	389,403	355,583	−33,820
Fremont	823,743	871,532	590,821	478,202	613,463	+135,261
Garfield	20,539	28,376	16,795	19,778	22,340	+2,562
Gunnison	477,674	618,894	479,007	437,522	542,992	+105,470
Huerfano	1,858,661	2,395,261	1,755,750	2,069,350	1,965,417	−103,933
Jackson and Jefferson	210,388	228,821	[a] 181,027	[a] 246,639	[a] 214,047	−[a] 32,592
La Plata	111,333	127,732	99,653	79,086	110,757	+31,671
Las Animas	3,303,970	4,219,086	2,727,713	3,370,064	3,189,502	−180,562
Mesa	116,321	170,256	113,761	151,937	180,574	+28,637
Pitkin and Rio Blanco	[b] 14,748	[b] 6,472	[b] 10,992	[a] [b] 12,226	[b] 15,836	+[a] [b] 3,610
Routt	1,181,332	964,342	889,015	432,198	803,455	+371,257
Weld	659,660	920,073	1,028,074	1,473,911	1,577,430	+103,519
Small mines	26,226	4,000	([c])	25,135	19,220	−5,915
	10,323,420	12,278,225	9,122,760	10,019,597	10,346,218	+326,621
Total value	$28,748,534	$42,829,000	$32,377,000	$31,701,000	$33,299,000	+$1,598,000

[a] Jackson and Jefferson include Elbert in 1921; Elbert and Pitkin in 1922; and Elbert in 1923.

[b] Moffat, Pitkin, and Rio Blanco in 1919; Moffat and Rio Blanco in 1920; Moffat, Montezuma, Ouray, Pitkin, and Rio Blanco in 1921; Moffat, Montezuma, Ouray, and Rio Blanco in 1922; and Archuleta, Moffat, Montezuma, Montrose, Pitkin, and Rio Blanco in 1923.

[c] No general canvass of wagon mines for 1921.

GEORGIA

Georgia reported an output in 1923 that was almost one-fourth greater than that of 1922 and the largest since 1917, and although the coal mining in this State is in some years limited to one operation there has been no break in the record for the State since 1860, the year it first reported a coal production. The output for 1923 was 75,620 tons, valued at $327,000, an increase in quantity of 14,984 tons and in value of $81,000. The mines were not in operation as many days but there were more employees than in the preceding year.

TABLE 88.—*Coal produced in Georgia, 1919–1923*

Year	Net tons					Value		Number of employees	Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton		
1919	15,028	679	4,600	33,030	53,337	$198,033	$3.71	168	284
1920	15,961	791	3,600	29,804	50,156	251,000	5.00	148	294
1921	18,755	373	1,979	12,708	33,815	171,000	2.14	136	183
1922	41,809	535	2,114	16,178	60,636	246,000	4.06	150	242
1923	48,172	733	2,554	24,161	75,620	327,000	4.32	167	231

ILLINOIS

In 1923 the production of coal in Illinois was 79,310,075 tons, valued at $198,388,000, which was greater than the output not only of 1922 but also of 1921—in fact, there have been but three years in the history of the State which recorded a larger production than that of 1923—1917, 1918, and 1920. The output in 1923 was 20,842,339 tons, or 35.6 per cent, greater in quantity than in 1922, and $29,463,000, or 17.4 per cent, greater in value. The average value, however, was less than in 1921 or 1922.

The mines worked on an average of only 158 days in 1923. For the first two months of the year car shortage was the principal cause of idleness claimed by the operators; after that no market restricted the activity of the mines. Very little time was lost on account of mine disability or labor shortage or strikes.

In Figure 47 is shown the average tonnage produced per day by years from 1918 to 1922 and by months for 1923; and also the scale of spot prices per ton for southern, central, and standard Illinois coal for the same period. The chart reveals very clearly the peculiar conditions of the market in 1923. In January the after-effects of the strike of 1922 were still felt. Consumers were buying to replenish their stocks, prices were high, and production was running at the limit of car supply. Continued purchasing for storage made the summer decline less sharp than usual. By late fall consumers had rebuilt their reserves, the peak of fall buying was correspondingly less pronounced, and in December prices were still softening and mines beginning to close.

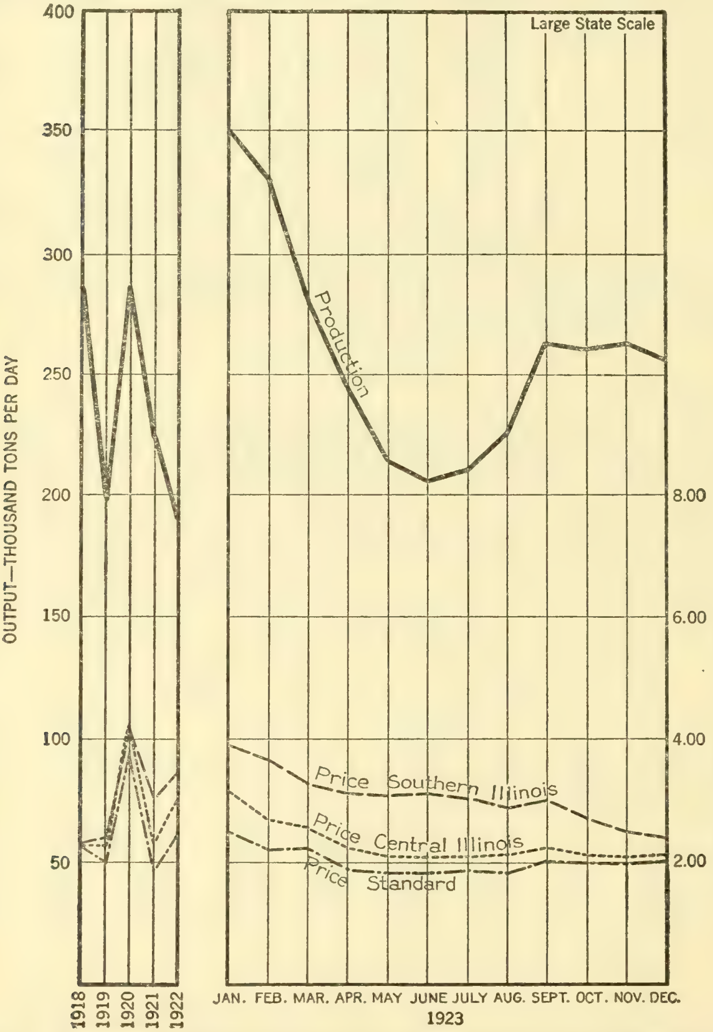

FIGURE 47.—Production of coal per working day in Illinois, and trend of spot prices, run-of-mine, in three districts, 1918–1923. Data from Tables 78 and 79; spot prices as quoted by Coal Age

TABLE 89.—*Coal produced in Illinois, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Underground		Surface	Total	
							Miners [a]	All others			
1922											
Bond, Johnson, and White	263, 879	13, 659	6, 639	284, 177	$829, 000	$2. 92	375	132	41	548	103
Bureau	325, 773	53, 148	28, 903	407, 824	1, 570, 000	3. 85	1, 089	369	157	1, 615	97
Cass, Hancock, Moultrie, Rock Island, and Scott	119, 909	61, 586	9, 160	190, 655	537, 000	2. 82	222	59	30	311	145
Christian	2, 735, 836	143, 046	37, 673	2, 916, 555	5, 951, 000	2. 04	2, 287	832	350	3, 469	129
Clinton	581, 259	44, 852	32, 045	658, 156	1, 690, 000	2. 57	878	331	117	1, 326	85
Franklin	8, 823, 740	133, 493	244, 100	9, 201, 333	31, 585, 000	3. 43	8, 754	4, 280	1, 769	14, 803	115
Fulton	1, 447, 575	73, 414	27, 785	1, 548, 774	4, 469, 000	2. 74	2, 024	597	439	3, 060	128
Gallatin	51, 496	1, 321	3, 314	56, 131	193, 000	3. 43	169	78	47	294	47
Greene	----------	3, 342	----------	3, 342	11, 000	3. 18	12	----------	----------	12	174
Grundy	125, 375	20, 841	9, 881	156, 097	670, 000	4. 29	330	77	43	450	136
Henry	----------	35, 261	2, 006	37, 267	143, 000	3. 83	64	9	8	81	220
Jackson	655, 322	51, 036	38, 943	745, 301	2, 405, 000	3. 23	1, 109	445	179	1, 733	92
Knox	1, 900	23, 457	555	25, 912	82, 000	3. 18	48	5	5	58	197
La Salle	214, 522	256, 097	12, 738	483, 357	1, 854, 000	3. 84	824	213	113	1, 150	148
Livingston	2, 550	27, 842	500	30, 892	126, 000	4. 10	54	21	10	85	125
Logan, McLean, Putnam, Will, and Woodford	433, 655	154, 419	43, 640	631, 714	2, 317, 000	3. 67	1, 145	357	166	1, 668	146
McDonough	----------	3, 552	----------	3, 552	17, 000	4. 74	17	2	1	20	121
Macon	37, 789	157, 171	7, 280	202, 240	768, 000	3. 80	279	135	37	451	172
Macoupin	4, 755, 945	90, 680	127, 838	4, 974, 463	12, 751, 000	2. 56	4, 529	2, 097	599	7, 225	117
Madison	3, 006, 424	214, 167	92, 539	3, 313, 130	9, 174, 000	2. 77	2, 856	1, 325	384	4, 565	131
Marion	595, 665	24, 722	37, 087	657, 474	1, 773, 000	2. 70	703	252	105	1, 060	143
Marshall	162, 066	62, 994	10, 198	235, 258	974, 000	4. 12	544	139	52	735	165
Menard	82, 940	58, 374	3, 983	145, 297	444, 000	3. 06	176	44	31	251	146
Mercer	68, 908	16, 237	2, 993	88, 138	279, 000	3. 16	127	36	64	227	99
Montgomery	1, 973, 303	37, 027	42, 355	2, 052, 685	5, 898, 000	2. 87	2, 209	931	299	3, 439	108
Peoria	871, 907	141, 653	11, 327	1, 024, 887	2, 841, 000	2. 77	1, 192	402	181	1, 775	154
Perry	1, 763, 124	84, 839	79, 461	1, 927, 424	5, 730, 000	2. 97	2, 284	902	430	3, 616	102
Randolph	1, 094, 069	34, 519	30, 289	1, 158, 877	3, 163, 000	2. 73	1, 409	589	180	2, 178	98
St. Clair	3, 896, 141	315, 926	106, 221	4, 318, 288	9, 888, 000	2. 33	4, 923	1, 633	627	7, 183	101
Saline	3, 571, 236	76, 274	101, 701	3, 749, 211	12, 368, 000	3. 30	3, 838	2, 133	695	6, 666	112
Sangamon	5, 047, 776	310, 220	103, 887	5, 461, 883	14, 233, 000	2. 61	6, 002	2, 081	743	8, 826	135
Schuyler	----------	5, 590	----------	5, 590	16, 000	2. 89	13	----------	----------	13	107

[a] Includes also loaders and shot firers.

TABLE 89.—*Coal produced in Illinois, 1922–23*—Continued

County	Net tons				Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Underground		Surface	Total	
							Miners [a]	All others			
1922—Continued											
Shelby	31, 181	19, 622	4, 775	55, 578	$196, 000	$3. 52	95	31	14	140	113
Stark	-----	10, 580	40	10, 620	37, 000	3. 50	21	2	3	26	200
Tazewell	526, 386	97, 726	7, 246	631, 358	1, 808, 000	2. 86	630	220	73	923	160
Vermilion	2, 654, 809	227, 788	37, 878	2, 920, 475	7, 795, 000	2. 67	2, 152	872	638	3, 662	159
Washington	485, 958	59, 307	20, 289	565, 554	1, 785, 000	3. 16	546	216	73	835	154
Williamson	7, 196, 519	81, 233	220, 410	7, 498, 162	22, 172, 000	2. 96	7, 663	2, 857	1, 337	11, 857	110
Total, excluding wagon mines	53, 604, 937	3, 227, 015	1, 545, 679	58, 377, 631	168, 542, 000	2. 89	61, 592	24, 704	10, 040	96, 336	120
Wagon mines served by rail	90, 105	-----	-----	90, 105	383, 000	4. 25	-----	-----	-----	-----	-----
Grand total	53, 695, 042	3, 227, 015	1, 545, 679	58, 467, 736	168, 925, 000	2. 89	-----	-----	-----	-----	-----
1923											
Bond, Jefferson, Johnson, and White	305, 768	9, 915	6, 384	322, 067	738, 000	2. 29	422	149	82	653	109
Bureau	429, 125	62, 212	34, 035	525, 372	1, 855, 000	3. 53	1, 041	317	157	1, 515	139
Cass, Edgar, Greene, Hancock, Moultrie, Schuyler, and Warren	104, 275	17, 152	9, 749	131, 176	344, 000	2. 62	149	35	17	201	176
Christian	3, 760, 389	172, 142	55, 451	3, 987, 982	8, 640, 000	2. 17	2, 463	879	441	3, 783	178
Clinton	636, 803	71, 569	36, 700	745, 072	1, 767, 000	2. 37	937	286	117	1, 340	90
Franklin	13, 286, 349	124, 149	285, 491	13, 695, 989	37, 711, 000	2. 75	9, 498	4, 791	1, 948	16, 237	166
Fulton	2, 051, 722	71, 758	27, 344	2, 150, 824	5, 864, 000	2. 73	2, 039	687	240	2, 966	172
Gallatin	26, 400	700	2, 000	29, 100	78, 000	2. 68	158	69	40	267	34
Grundy	164, 910	16, 422	12, 805	194, 137	774, 000	3. 99	260	96	44	400	199
Henry	20, 000	36, 624	1, 756	58, 380	177, 000	3. 03	90	17	16	123	185
Jackson	1, 267, 348	51, 639	35, 097	1, 354, 084	3, 409, 000	2. 52	1, 035	408	206	1, 649	156
Knox	-----	15, 636	508	16, 144	48, 000	2. 97	33	5	5	43	167
La Salle	227, 643	304, 457	13, 583	545, 683	1, 918, 000	3. 51	629	169	125	923	198
Livingston	3, 863	38, 218	1, 470	43, 551	159, 000	3. 65	110	24	16	150	121
Logan, McLean, Putnam, Will, and Woodford	681, 793	157, 402	45, 026	884, 221	2, 458, 000	2. 78	1, 158	317	163	1, 638	215
McDonough	-----	2, 861	-----	2, 861	12, 000	4. 19	16	-----	-----	16	92
Macon	20, 037	170, 274	7, 347	197, 658	777, 000	3. 93	266	139	30	435	167
Macoupin	6, 966, 593	114, 167	192, 730	7, 273, 490	16, 634, 000	2. 29	4, 738	2, 078	620	7, 436	165

Madison	3, 416, 031	280, 526	114, 288	3, 810, 845	9, 110, 000	2. 39	2, 914	1, 209	357	4, 480	147
Marion	638, 148	37, 940	44, 200	720, 288	1, 748, 000	2. 43	671	226	101	998	155
Marshall	283, 263	22, 830	11, 982	318, 075	1, 228, 000	3. 86	517	133	50	700	228
Menard	21, 193	50, 994	2, 164	74, 351	227, 000	3. 05	160	48	31	239	101
Mercer	119, 903	10, 277	1, 275	131, 455	385, 000	2. 93	112	31	21	164	214
Montgomery	2, 645, 489	43, 038	64, 363	2, 752, 890	6, 829, 000	2. 48	2, 371	1, 055	303	3, 729	143
Peoria	1, 013, 860	127, 252	9, 656	1, 150, 768	3, 015, 000	2. 62	1, 070	346	136	1, 552	185
Perry	2, 293, 692	147, 767	83, 089	2, 524, 548	5, 223, 000	2. 07	2, 498	903	466	3, 867	123
Randolph	1, 635, 369	31, 806	35, 297	1, 702, 472	4, 188, 000	2. 46	1, 387	609	204	2, 200	149
Rock Island	3, 000	25, 200	1, 067	29, 267	77, 000	2. 63	48	11	6	65	138
St. Clair	4, 643, 852	384, 072	124, 024	5, 151, 948	10, 821, 000	2. 10	4, 780	1, 362	618	6, 760	133
Saline	5, 134, 291	66, 733	131, 877	5, 332, 901	14, 283, 000	2. 68	4, 745	2, 020	801	7, 566	138
Sangamon	7, 040, 597	309, 594	126, 854	7, 477, 045	17, 369, 000	2. 32	6, 093	2, 114	835	9, 042	179
Shelby	28, 878	26, 761	4, 000	59, 639	210, 000	3. 52	127	34	16	177	160
Stark		8, 639	5	8, 644	31, 000	3. 59	20	1	2	23	180
Tazewell	630, 205	132, 353	7, 929	770, 487	2, 081, 000	2. 70	610	166	72	848	216
Vermilion	3, 799, 454	324, 640	52, 575	4, 176, 669	10, 571, 000	2. 53	2, 202	873	700	3, 775	232
Washington	410, 613	44, 143	15, 475	470, 231	1, 279, 000	2. 72	454	215	66	735	117
Williamson	10, 073, 511	94, 907	263, 322	10, 431, 740	26, 170, 000	2. 51	8, 373	3, 078	1, 568	13, 019	139
Total, excluding wagon mines	73, 784, 367	3, 606, 769	1, 860, 918	79, 252, 054	198, 208, 000	2. 50	64, 194	24, 900	10, 620	99, 714	158
Wagon mines served by rail	58, 021			58, 021	180, 000	3. 10					
Grand total	73, 842, 388	3, 606, 769	1, 860, 918	79, 310, 075	198, 388, 000	2. 50					

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[a] Includes also loaders and shot firers.

TABLE 90.—*Coal produced in Illinois, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Bond and White	249, 326	381, 586	[a] 365, 664	[a] 284, 177	[a] 322, 067	+[a] 37, 890
Bureau	927, 615	859, 287	556, 671	407, 824	525, 372	+117, 548
Christian	2, 253, 181	3, 392, 547	2, 950, 910	2, 916, 555	3, 987, 982	+1, 071, 427
Clinton	1, 176, 836	1, 311, 750	802, 228	658, 156	745, 072	+86, 916
Franklin	9, 799, 321	12, 837, 993	11, 947, 539	9, 201, 333	13, 695, 989	+4, 494, 656
Fulton	1, 522, 918	2, 712, 598	1, 471, 137	1, 548, 774	2, 150, 824	+602, 050
Gallatin	[b] 185, 681	[b] 198, 208	145, 618	56, 131	29, 100	−27, 031
Greene	[c] 332, 416	[c] 258, 994	6, 959	3, 342	(c)	(c)
Grundy	191, 874	245, 954	202, 926	156, 097	194, 137	+38, 040
Hancock, Schuyler, Scott, and Warren	12, 030	[d] 7, 798	[d] 189, 107	[d] 196, 245	[d] 131, 176	−[d] 39, 144
Henry	24, 637	24, 809	26, 029	37, 267	58, 380	+21, 113
Jackson	1, 054, 912	1, 037, 844	1, 113, 612	745, 301	1, 354, 084	+608, 783
Knox	10, 910	24, 089	31, 206	25, 912	16, 144	−9, 768
La Salle	749, 704	874, 362	384, 813	483, 357	545, 683	+62, 326
Livingston	103, 647	112, 449	97, 910	30, 892	43, 551	+12, 659
Logan, McLean, Putnam, Will, and Woodford	928, 338	1, 149, 956	751, 506	631, 714	884, 221	+252, 507
McDonough	------	------	7, 534	3, 552	2, 861	−691
Macon	(c)	290, 899	226, 734	202, 240	197, 658	−4, 582
Macoupin	4, 730, 376	8, 747, 111	6, 230, 953	4, 974, 463	7, 273, 490	+2, 299, 027
Madison	3, 217, 111	4, 814, 927	3, 278, 582	3, 313, 130	3, 810, 845	+497, 715
Marion	768, 952	988, 773	705, 734	657, 474	720, 288	+62, 814
Marshall	258, 919	300, 073	229, 907	235, 258	318, 075	+82, 817
Menard	138, 291	205, 878	123, 341	145, 297	74, 351	−70, 946
Mercer	167, 517	221, 226	185, 342	88, 138	131, 455	+43, 317
Montgomery	2, 007, 419	3, 973, 642	2, 279, 493	2, 052, 685	2, 752, 890	+700, 205
Peoria	752, 172	1, 366, 816	1, 102, 002	1, 024, 887	1, 150, 768	+125, 881
Perry	2, 348, 124	2, 802, 594	2, 403, 471	1, 927, 424	2, 524, 548	+597, 124
Randolph	1, 089, 998	1, 595, 723	1, 810, 158	1, 158, 877	1, 702, 472	+543, 595
Rock Island	29, 297	93, 577	65, 916	(d)	29, 267	(d)
St. Clair	4, 204, 808	7, 252, 869	5, 195, 602	4, 318, 288	5, 151, 948	+833, 660
Saline	3, 952, 785	5, 384, 912	4, 532, 475	3, 749, 211	5, 332, 901	+1, 583, 690
Sangamon	5, 218, 581	8, 567, 014	5, 956, 755	5, 461, 883	7, 477, 045	+2, 015, 162
Shelby	200, 678	(c)	76, 320	55, 578	59, 639	+4, 061
Stark	12, 714	6, 185	8, 460	10, 620	8, 644	−1, 976
Tazewell	434, 956	925, 627	691, 359	631, 358	770, 487	+139, 129
Vermilion	2, 573, 913	3, 966, 506	3, 040, 165	2, 920, 475	4, 176, 669	+1, 256, 194
Washington	562, 408	769, 697	908, 797	565, 554	470, 231	−95, 323
Williamson	8, 606, 841	10, 926, 620	9, 499, 828	7, 498, 162	10, 431, 740	+2, 933, 578
Small mines	63, 402	94, 000	(e)	90, 105	58, 021	−32, 084
	60, 862, 608	88, 724, 893	69, 602, 763	58, 467, 736	79, 310, 075	+20, 842, 339
Total value	$140, 075, 969	$273, 509, 000	$190, 986, 000	$168, 925, 000	$198, 388, 000	+$29, 463, 000

[a] Bond and White include Johnson in 1921 and 1922, and Jefferson and Johnson in 1923.

[b] Johnson included with Gallatin in 1919 and 1920; with Bond and White in 1921, 1922, and 1923.

[c] Greene includes Macon and Moultrie in 1919; and Moultrie and Shelby in 1920; Moultrie included with Hancock, etc., in 1921; and Greene and Moultrie included with Hancock, etc., 1923.

[d] No production in Scott in 1920; includes Cass and Moultrie in 1921; no production in Warren, but includes Cass, Moultrie, and Rock Island in 1922; no production in Scott, but includes Cass, Edgar, Greene, and Moultrie in 1923.

[e] No canvass of wagon mines for 1921.

INDIANA

In Indiana, as in Illinois, the output of coal in 1923 made this the fourth best year in the State's history, having been exceeded only in 1917, 1918, and 1920. The coal mined in 1923 amounted to 26,229,099 tons, with a total value of $65,046,000 and an average value per ton of $2.48; this indicated an increase of 7,096,210 tons, or 37.1 per cent, in quantity, and $10,522,000, or 19.3 per cent, in value over 1922.

The average number of days worked during the year was 136, less than half the potential working days. The causes of the idleness were similar to those in Illinois—car shortage in the early weeks of the year, soon followed by no market. Little time was lost in 1923 through strikes.

The tons mined per day for the 5 years preceding 1923 and for the 12 months of that year are pictured in the accompanying graph (fig. 48), on which the scale is the same as that for Illinois. These averages were almost the same in 1918 and 1920, nearly 100,000 tons, fell to a level of about 67,000 tons in 1919 and 1921, and showed a continued decline in 1922. In January, 1923, the daily average was 110,000 tons; it steadily dropped till May, rose to 92,000 tons in September, and ended the year at about 86,000 tons.

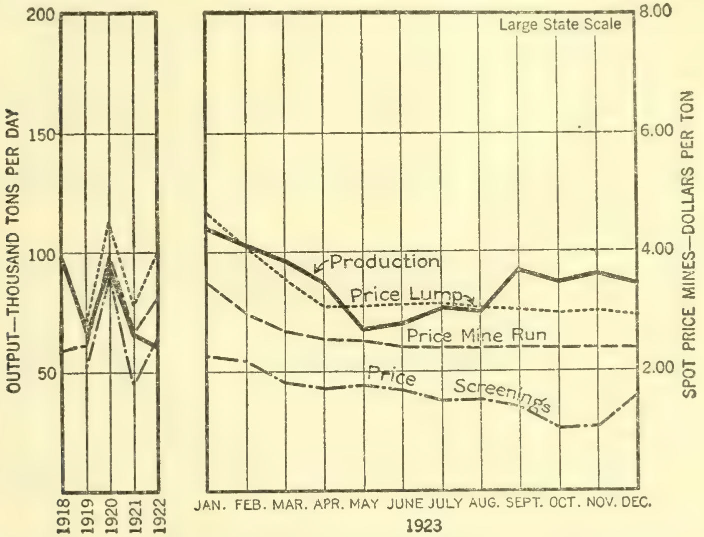

FIGURE 48.—Production of coal per working day in Indiana and trend of spot prices on fourth and fifth vein coal, 1918–1923. Data from Tables 78 and 79; spot prices as quoted by Coal Age

The spot prices per ton for the fourth and fifth vein lump and mine-run coals and screenings as quoted by Coal Age are shown on this diagram for the same years except 1918, when these data were not available. Lump coal, which had brought an average price of $2.71 in 1919 and $4.52 in 1920, was quoted at $4.70 in January, 1923, then followed a descending scale or maintained a lower level throughout the year. Mine-run, which had sold for an average of $3.98 in 1920, was quoted at $2.38 in the later months of 1923. Screenings were sold as low as $1.06 in October and November, 1923.

TABLE 91.—*Coal produced in Indiana, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
							Underground				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Miners [a]	All others	Surface	Total	
1922											
Clay	415,846	23,137	13,918	452,901	$1,243,000	$2.75	539	187	280	1,006	81
Crawford and Dubois	--------	1,200	--------	1,200	4,500	3.75	3	1	1	5	160
Daviess	105,208	13,217	5,369	123,794	339,000	2.74	227	73	57	357	80
Fountain and Warren	--------	2,640	--------	2,640	9,500	3.60	11	--------	--------	11	135
Gibson	479,328	18,711	15,663	513,702	1,314,000	2.56	680	296	90	1,066	95
Greene	1,876,292	29,482	40,671	1,946,445	5,228,000	2.69	1,907	777	515	3,199	107
Knox	2,420,855	43,940	42,268	2,507,063	7,235,000	2.88	2,713	952	394	4,059	102
Owen	39,221	791	815	40,827	125,000	3.07	18	1	43	62	109
Parke	92,507	20,068	3,971	116,546	341,000	2.92	158	39	24	221	156
Perry	--------	8,500	--------	8,500	23,000	2.70	15	3	1	19	205
Pike	1,329,380	17,105	12,843	1,359,328	3,836,000	2.82	937	423	405	1,765	124
Spencer	9,975	2,665	100	12,740	39,000	3.06	22	4	5	31	225
Sullivan	3,084,954	35,205	64,525	3,184,684	9,113,000	2.86	3,410	1,609	783	5,802	109
Vanderburg	74,514	128,063	6,101	208,678	583,000	2.79	299	90	27	416	133
Vermilion	2,038,899	44,830	63,119	2,146,848	5,910,000	2.75	2,648	1,036	380	4,064	113
Vigo	5,244,174	110,948	164,096	5,519,218	16,338,000	2.96	6,149	2,490	812	9,451	115
Warrick	749,059	36,808	19,443	805,310	2,069,000	2.57	869	307	498	1,674	109
Total, excluding wagon mines	17,960,212	537,310	452,902	18,950,424	53,750,000	2.84	20,605	8,288	4,315	33,208	110
Wagon mines served by rail	182,465	--------	--------	182,465	774,000	4.24	--------	--------	--------	--------	--------
Grand total	18,142,677	537,310	452,902	19,132,889	54,524,000	2.85	--------	--------	--------	--------	--------
1923											
Clay	580,068	56,706	8,619	645,393	1,394,000	2.16	585	208	297	1,090	100
Daviess	142,253	21,589	8,089	171,931	364,000	2.11	197	81	39	317	105
Dubois and Perry	--------	7,351	104	7,455	22,000	2.95	11	4	2	17	191
Fountain and Warren	--------	2,514	--------	2,514	10,000	3.98	9	--------	--------	9	189
Gibson	506,235	15,495	20,470	542,200	1,272,000	2.34	707	263	86	1,056	100
Greene	2,309,237	55,690	28,395	2,393,322	5,767,000	2.41	1,731	633	548	2,912	121
Knox	3,404,670	44,501	61,671	3,510,842	8,276,000	2.36	2,840	960	330	4,130	134

Owen	90, 714	1, 162	2, 110	93, 986	241, 000	2. 56	16	3	77	96	118
Parke	82, 644	23, 642	3, 977	110, 263	259, 000	2. 35	148	42	27	217	129
Pike	1, 749, 939	29, 264	39, 121	1, 818, 324	4, 092, 000	2. 25	1, 089	393	498	1, 980	136
Spencer	4, 467	2, 270	140	6, 877	14, 000	2. 04	27	7	4	38	65
Sullivan	5, 372, 203	54, 411	83, 896	5, 510, 510	13, 601, 000	2. 47	4, 244	1, 947	814	7, 005	150
Vanderburg	120, 507	178, 772	9, 305	308, 584	810, 000	2. 62	256	93	37	386	167
Vermilion	3, 101, 624	34, 760	110, 914	3, 247, 298	8, 019, 000	2. 47	3, 422	1, 095	471	4, 988	145
Vigo	6, 458, 083	144, 357	179, 295	6, 781, 735	18, 470, 000	2. 72	6, 691	2, 200	770	9, 661	134
Warrick	937, 801	25, 348	23, 512	986, 661	2, 152, 000	2. 18	804	299	403	1, 506	127
Total, excluding wagon mines	24, 860, 445	697, 832	579, 618	26, 137, 895	64, 763, 000	2. 48	22, 777	8, 228	4, 403	35, 408	136
Wagon mines served by rail	91, 204			91, 204	283, 000	3. 10					
Grand total	24, 951, 640	697, 832	579, 618	26, 229, 099	65, 046, 000	2. 48					

[a] Includes also loaders and shot firers.

TABLE 92.—*Coal produced in Indiana, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Clay	1, 006, 780	1, 370, 402	547, 480	452, 901	645, 393	+192, 492
Daviess	320, 249	343, 572	271, 104	123, 794	171, 931	+48, 137
Dubois	[a] 25, 500	[a] 7, 675	[a] 9, 144	[a] 1, 200	[a] 7, 455	−[a] 2, 245
Fountain and Warren	13, 317	2, 571	2, 527	2, 640	2, 514	−126
Gibson	476, 613	823, 057	658, 127	513, 702	542, 200	+28, 498
Greene	2, 021, 868	2, 878, 868	1, 885, 479	1, 946, 445	2, 393, 322	+446, 877
Knox	2, 965, 658	3, 705, 711	2, 736, 111	2, 507, 063	3, 510, 842	+1, 003, 779
Owen	97, 115	121, 928	77, 345	40, 827	93, 986	+53, 159
Parke	92, 912	105, 254	28, 249	116, 546	110, 263	−6, 283
Perry	(a)	15, 997	8, 064	8, 500	(a)	(a)
Pike	1, 024, 973	1, 422, 013	1, 035, 469	1, 359, 328	1, 818, 324	+458, 996
Spencer	25, 720	32, 713	7, 472	12, 740	6, 877	−5, 863
Sullivan	3, 096, 059	4, 523, 306	3, 418, 435	3, 184, 684	5, 510, 510	+2, 325, 826
Vanderburg	264, 760	370, 993	224, 665	208, 678	308, 584	+99, 906
Vermilion	2, 844, 845	3, 551, 187	2, 185, 886	2, 146, 848	3, 247, 298	+1, 100, 450
Vigo	5, 802, 244	8, 232, 106	6, 364, 245	5, 519, 218	6, 781, 735	+1, 262, 517
Warrick	781, 317	1, 583, 232	859, 707	805, 310	986, 661	+181, 351
Small mines	52, 358	260, 000	(b)	182, 465	91, 204	−91, 261
	20, 912, 288	29, 350, 585	20, 319, 509	19, 132, 889	26, 229, 099	+7, 096, 210
Total value	$46, 345, 750	$92, 867, 000	$52, 269, 000	$54, 524, 000	$65, 046, 000	+$10,522,000

[a] Dubois includes Perry in 1919 and 1923; and Crawford in 1920, 1921, and 1922.
[b] No canvass of wagon mines for 1921.

IOWA

The production of coal in Iowa in 1923 was 5,710,735 tons, with a value of $20,517,000, an increase over that of 1922 of 1,375,574 tons, or 31.7 per cent, in quantity, and of $4,398,000, or 27.3 per cent, in value. The number of employees, 11,448, was fewer than in 1922, but the average number of days worked was greater—181, as compared with 131.

The average quantity produced per day in Iowa and the neighboring trans-Mississippi States for the years 1918–1922 and for each month in 1923 is shown in Figure 49. Conditions were not unlike in these States, varying in degree only.

TABLE 93.—*Coal produced in Iowa, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Underground		Surface	Total	
							Miners [a]	All others			
1922											
Adams		2,140		2,140	$10,000	$4.57	9			9	186
Appanoose	761,209	48,240	12,854	822,303	3,187,000	3.88	2,366	613	260	3,239	120
Boone	176,024	39,900	7,868	223,792	1,058,000	4.72	439	220	53	712	142
Dallas	299,640	11,289	1,842	312,771	1,137,000	3.64	448	198	62	708	154
Greene, Guthrie, Hardin, Lucas, Warren, and Wayne	470,297	70,352	14,245	554,894	1,739,000	3.13	936	750	96	1,782	125
Jasper	69,261	7,395	4,478	81,134	331,000	4.08	163	107	41	311	79
Jefferson, Keokuk, and Van Buren	7,052	7,300	125	14,477	44,000	3.04	18	3	2	23	226
Mahaska	20,514	8,150	624	29,288	98,000	3.36	81	14	9	104	111
Marion	483,125	36,935	13,847	533,907	1,930,000	3.62	851	303	111	1,265	135
Monroe	978,614	30,055	27,629	1,036,298	3,675,000	3.55	1,862	698	191	2,751	137
Page and Taylor	7,809	28,372	2	36,183	168,000	4.64	70	6	4	80	227
Polk	340,059	265,840	17,973	623,872	2,505,000	4.02	1,066	555	175	1,796	134
Wapello	848	23,939	415	25,202	81,000	3.23	60	10	7	77	128
Total, excluding wagon mines	3,614,452	579,907	101,902	4,296,261	15,963,000	3.72	8,369	3,477	1,011	12,857	131
Wagon mines served by rail	38,900			38,900	156,000	4.00					
Grand total	3,653,352	579,907	101,902	4,335,161	16,119,000	3.72					
1923											
Appanoose	863,671	48,737	19,259	931,667	3,464,000	3.72	2,364	488	248	3,100	146
Boone	216,092	46,235	2,107	264,434	1,222,000	4.62	402	215	51	668	178
Dallas	527,520	14,430	3,911	545,861	1,915,000	3.51	646	272	90	1,008	213
Guthrie, Lucas, and Wayne	696,154	9,144	19,821	725,119	2,509,000	3.46	617	247	76	940	187
Jasper	81,852	15,223	6,316	103,391	363,000	3.51	122	70	27	219	142
Jefferson, Keokuk, and Van Buren	6,927	7,659		14,586	41,000	2.81	26	3	2	31	193
Mahaska	26,702	9,720	989	37,411	130,000	3.47	72	12	7	91	169
Marion	675,054	42,686	22,577	740.317	2,478,000	3.35	850	337	111	1,298	203
Monroe	1,490,213	32,536	35,033	1,557,732	5,510,000	3.53	1,630	601	180	2,411	198
Page and Taylor	9,954	18,685		28,639	136,000	4.75	57	14	6	77	219
Polk	380,606	274,802	12,423	667,831	2,428,000	3.63	852	397	122	1,371	191
Wapello	150	32,267	650	33,067	108,000	3.27	67	10	6	83	146
Warren	43,857	4,056	3,967	51,880	187,000	3.60	92	43	16	151	174
Total, excluding wagon mines	5,018,752	556,180	127,053	5,701,985	20,491,000	3.59	7,797	2,709	942	11,448	181
Wagon mines served by rail	8,750			8,750	26,000	3.00					
Grand total	5,027,502	556,180	127,053	5,710,735	20,517,000	3.59					

[a] Includes also loaders and shot firers.

TABLE 94.—*Coal produced in Iowa, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Adams	7,418	8,419	[a] 25,821	2,140	------------	−2,140
Appanoose	988,225	1,511,599	609,397	822,303	931,667	+109,364
Boone	242,009	322,517	198,738	223,792	264,434	+40,642
Dallas	279,644	444,670	309,888	312,771	545,861	+233,090
Greene and Guthrie	[b] 479,115	[b] 328,215	58,092	[b] 554,894	[b] 725,119	+[b] 222,105
Jasper	138,171	([b])	108,410	81,134	103,391	+22,257
Jefferson and Keokuk	8,072	1,726	[c] 11,590	[c] 14,477	[c] 14,586	+[c] 109
Lucas	([b])	397,682	236,823	([b])	([b])	([b])
Mahaska	73,409	64,430	47,751	29,288	37,411	+8,123
Marion	508,767	805,723	583,188	533,907	740,317	+206,410
Monroe	1,734,633	2,503,276	1,519,291	1,036,298	1,557,782	+521,484
Page and Taylor	12,873	22,906	([a])	36,183	28,639	−7,544
Polk	945,113	1,183,822	750,351	623,872	667,831	+43,959
Van Buren	6,667	8,845	([c])	([c])	([c])	([c])
Wapello	169,500	143,793	50,499	25,202	33,067	+7,865
Warren	([b])	([b])	([b])	([b])	51,880	([b])
Wayne	10,588	27,293	21,553	([b])	([b])	([b])
Small mines	20,488	39,000	([d])	38,900	8,750	−30,150
	5,624,692	7,813,916	4,531,392	4,335,161	5,710,735	+1,375,574
Total value	$17,352,620	$30,794,000	$17,256,800	$16,119,000	$20,517,000	+$4,398,000

[a] Adams includes Page and Taylor in 1921.

[b] Greene, etc., includes Lucas and Warren in 1919; Jasper and Warren in 1920; Hardin, Lucas, Warren, and Wayne in 1922; and Lucas and Wayne in 1923.

[c] Jefferson and Keokuk include Van Buren in 1921, 1922, and 1923.

[d] No canvass of wagon mines for 1921.

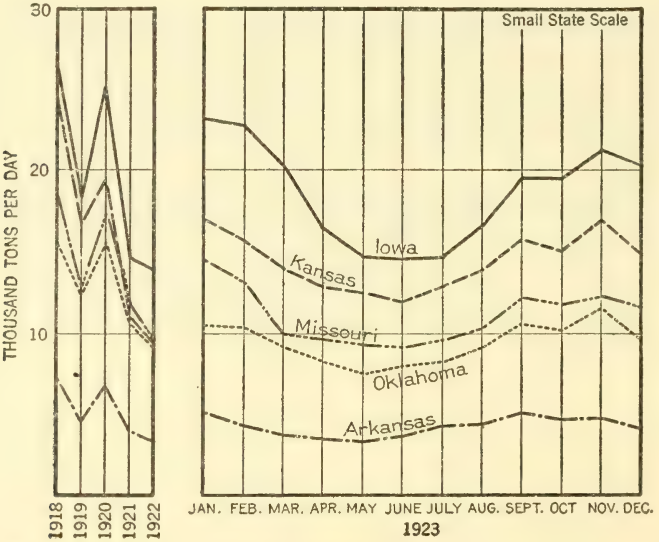

FIGURE 49.—Production of coal per working day in Iowa, Kansas, Missouri, Arkansas, and Oklahoma, 1918–1923. Data from Table 78

KANSAS

The output of coal in Kansas was greater in 1923 than in 1921 or 1922, but with these exceptions it was less than for any year since 1899, when 3,852,267 tons was produced. The production in 1923 was 4,443,149 tons, with a total value of $14,275,000 and an average value of $3.21.

The tons mined per day in the months of 1923 and the five preceding years are charted in Figure 49.

The statistics of coal production in Kansas published by the Geological Survey for the years 1921 and 1922 are now known to have been incomplete. For those years the Survey relied entirely upon correspondence in collecting the statistics and neither sent an agent into the field nor checked its returns against those of the State mine officials. The market conditions were such as to stimulate the activity of small mines and cooperative mines not bound by the union scale, and later comparison with the returns of the State Coal Mine Inspection Department showed that the Survey had failed to obtain reports from all the mines operating in those years. Thus in 1922 the mines reporting to the State inspection department produced 3,318,243 tons, and the department estimated an additional quantity of 200,000 tons from miscellaneous small mines. The production of the mines reporting to the Geological Survey (Table 95) for 1922 was 2,955,170 tons, of which 178,924 tons came from wagon mines served by rail. The details by counties in the State report are given in the footnote to Table 95. In 1921 the State inspection department showed a total output of 4,028,624 tons, including its estimate for the small mines, against a figure of 3,466,641 tons published by the Geological Survey. For 1923 and for years prior to 1921 there is no material discrepancy between the State and Survey figures.

TABLE 95.—*Coal produced in Kansas, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Underground		Surface	Total	
							Miners [a]	All others			
1922 [b]											
Cherokee	385, 031	10, 479	9, 798	405, 308	$1, 378, 000	$3. 40	449	135	268	852	108
Crawford	2, 115, 586	35, 917	50, 102	2, 201, 605	7, 937, 000	3. 60	4, 123	995	606	5, 724	116
Leavenworth and Osage	98, 314	46, 235	828	145, 377	645, 000	4. 44	487	180	68	735	204
Linn	19, 436	4, 200	320	23, 956	78, 000	3. 26	34	9	5	48	179
Total, excluding wagon mines	2, 618, 367	96, 831	61, 048	2, 776, 246	10, 038, 000	3. 61	5, 093	1, 319	947	7, 359	125
Wagon mines served by rail	178, 924			178, 924	778, 000	4. 35					
Grand total	2, 797, 291	96, 831	61, 048	2, 955, 170	10, 816, 000	3. 66					
1923											
Cherokee	649, 940	57, 747	17, 479	725, 166	2, 151, 000	2. 97	726	139	333	1, 198	121
Crawford	3, 188, 543	157, 663	63, 918	3, 410, 124	10, 986, 000	3. 22	5, 460	1, 325	675	7, 460	138
Leavenworth and Osage	101, 503	49, 872	668	152, 043	620, 000	4. 08	628	155	97	880	189
Linn	37, 645	2, 800	210	40, 655	143, 000	3. 51	152	43	28	223	73
Total, excluding wagon mines	3, 977, 631	268, 082	82, 275	4, 327, 988	13, 900, 000	3. 21	6, 966	1, 662	1, 133	9, 761	139
Wagon mines served by rail	115, 161			115, 161	375, 000	3. 26					
Grand total	4, 092, 792	268, 082	82, 275	4, 443, 149	14, 275, 000	3. 21					

[a] Includes also loaders and shot firers.

[b] These figures for 1922 are incomplete. The State Coal Mine Inspection Department gives the following figures for 1922, which are believed to be complete: Cherokee County, 548,764 tons, 1,351 men; Crawford County, 2,418,572 tons, 7,073 men; Leavenworth County, 163,868 tons, 187 men; Osage County, 92,787 tons, 504 men; Linn County, 94,252 tons, 261 men; total mines reporting, 3,318,243 tons, 9,376 men; estimated small mines not reporting, 200,000 tons, 250 men; grand total, including estimate, 3,518,243 tons, 9,626 men.

TABLE 96.—*Coal produced in Kansas, 1919–1923, in net tons*

County	1919	1920	1921 [a]	1922 [a]	1923
Cherokee	884, 732	1, 090, 186	570, 601	405, 308	725, 166
Crawford	4, 148, 172	4, 508, 747	2, 713, 007	2, 201, 605	3, 410, 124
Leavenworth	89, 709	143, 270	133, 904	[b] 145, 377	[b] 152, 043
Linn	10, 981	[c] 13, 841	7, 459	23, 956	40, 655
Osage	71, 300	82, 364	41, 670	([b])	([b])
Small mines	19, 830	88, 000	([d])	178, 924	115, 161
	5, 224, 724	5, 926, 408	3, 466, 641	2, 955, 170	4, 443, 149
Total value	$15, 917, 053	$22, 923, 000	$13, 333, 300	$10, 816, 000	$14, 275, 000

[a] Figures for 1921 and 1922 are incomplete. The State Coal Mine Inspection Department reports 4,028,624 tons produced in 1921 and 3,518,243 tons produced in 1922. See Table 95, note [b].

[b] Leavenworth includes Osage.

[c] Includes Bourbon.

[d] No canvass of wagon mines for 1921.

KENTUCKY

Again Kentucky broke its own record with the output of coal in 1923, although the rate of increase was not so great as in most of the other States. The production was 44,777,317 tons, a gain of 2,643,142 tons, or 6.3 per cent, over that of 1922. This gain lay entirely in the eastern part of the State, not a single county in western Kentucky recording an increase. The wagon mines served by rail showed a loss of 361,568 tons, or 77 per cent. Although the total value of the eastern Kentucky coal was $7,295,000 greater than in the preceding year, that for the western district fell off $19,011,000, and there was a drop of $1,779,000 in the value of the coal from wagon mines; the net decrease for the State was therefore $13,495,000, or 10.6 per cent.

There is a marked difference in the average number of days worked in the two districts—161 in the eastern and only 127 in the western.

The accompanying diagram (fig. 50) shows the course of daily production for the State as a whole and the average spot prices per ton for the two districts, for the years 1918 to 1922 and for 1923 by months. From 1918, when the daily output averaged about 103,000 tons, to January, 1923, the increase was 38,000 tons, or 37 per cent, and to October (the highest point reached in the period charted) the daily average increased 64,000 tons, or 62 per cent. March showed the lowest average in 1923. Spot prices in both eastern and western Kentucky declined steadily throughout the year, except for a temporary recovery in western Kentucky during August and September.

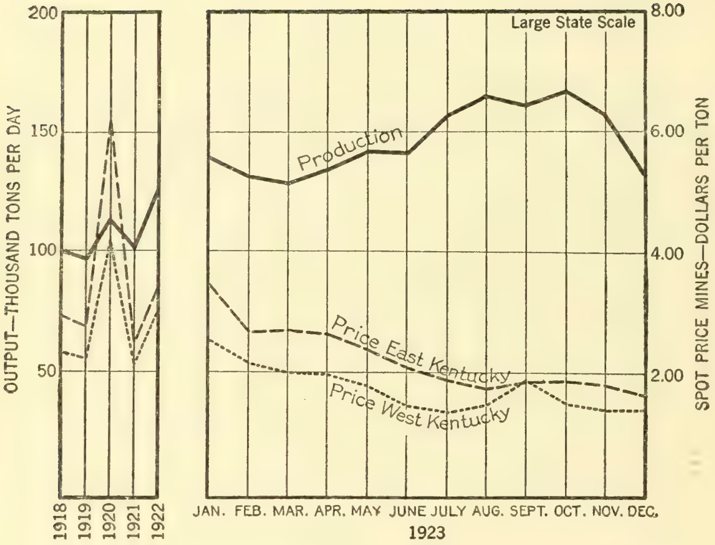

FIGURE 50.—Production of coal per working day in Kentucky, and trend of spot prices, run-of-mine grade, for eastern and western Kentucky, 1918–1923. Data from Tables 78 and 79; spot prices as quoted by Coal Age

TABLE 97.—*Coal produced in Kentucky, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1922												
Eastern district:												
Bell	1,787,768	46,500	25,145		1,859,413	$5,816,000	$3.13	2,646	1,177	928	4,751	100
Boyd	110,180	4,928	1,348		116,456	242,000	2.08	143	45	36	224	127
Breathitt	276,339	16,881	1,491		294,711	777,000	2.63	410	168	119	697	112
Carter	143,164	18,392	530		162,086	528,000	3.26	213	77	75	365	181
Clay	135,154	3,110	1,250		139,514	365,000	2.62	178	93	72	343	129
Floyd	2,604,062	45,473	37,327		2,686,862	7,584,000	2.82	2,332	1,093	774	4,199	142
Harlan	6,095,344	53,825	41,192	41,614	6,231,975	17,351,000	2.78	4,601	2,556	1,650	8,807	105
Johnson	321,984	8,388	14,809		345,181	1,396,000	4.05	670	233	177	1,080	71
Knott	211,935	2,242			214,177	540,000	2.52	106	41	19	166	230
Knox	436,299	5,411	8,651		450,361	1,468,000	3.26	548	319	214	1,081	125
Laurel	147,432	14,403	400		162,235	584,000	3.59	308	91	65	464	148
Lawrence	45,011	194	500		45,705	141,000	3.12	74	34	38	146	191
Lee	179,703	5,207	1,804		186,714	479,000	2.56	220	110	79	409	102
Letcher	3,577,447	39,787	41,415		3,658,649	11,977,000	3.27	2,219	1,248	790	4,257	143
McCreary	693,351	5,970	3,317		702,638	2,025,000	2.88	759	394	123	1,276	164
Martin	310,384	1,430	5,904		317,718	997,000	3.14	205	120	81	406	173
Morgan	42,541	7,417	1,573		51,531	283,000	5.50	159	46	94	299	174
Perry	4,226,217	60,728	1,076		4,288,021	12,544,000	2.93	3,034	1,350	1,071	5,455	148
Pike	5,467,091	122,398	70,038	12,045	5,671,572	16,502,000	2.91	3,454	1,977	1,359	6,790	170
Whitley	317,082	13,459	13,179		343,720	1,294,000	3.76	914	219	305	1,438	100
Other counties [b]	1,160	1,600			2,760	10,000	3.62	7			7	200
	27,129,648	477,743	270,949	53,659	27,931,999	82,903,000	2.97	23,200	11,391	8,069	42,660	133
Western district:												
Christian, Crittenden, and Hancock	56,522	4,266	3,439		64,227	231,000	3.60	186	55	46	287	88
Daviess	136,929	16,721	2,150		155,800	465,000	2.98	123	58	28	209	217
Henderson	586,167	71,599	19,314		677,080	2,286,000	3.38	514	221	84	819	200
Hopkins	3,267,514	158,257	51,017		3,476,788	9,919,000	2.85	2,706	1,060	796	4,562	136
McLean	149,480	11,844	2,995		164,319	451,000	2.74	195	63	28	286	105
Muhlenberg	4,142,230	171,048	72,355		4,385,633	14,045,000	3.20	3,751	1,589	655	5,995	156
Ohio	1,136,726	24,763	34,293		1,195,782	3,557,000	2.98	1,211	499	293	2,003	140
Union	1,327,476	39,798	49,612		1,416,886	4,416,000	3.12	936	400	181	1,517	218
Webster	2,154,048	15,106	28,454		2,197,608	6,664,000	3.03	1,367	871	348	2,586	177
	12,957,092	513,402	263,629		13,734,123	42,034,000	3.06	10,989	4,816	2,459	18,264	158
All Kentucky	40,086,740	991,145	534,578	53,659	41,666,122	124,937,000	3.00	34,189	16,207	10,528	60,924	140
Wagon mines served by rail	468,053				468,053	2,100,000	4.45					
Grand total	40,554,793	991,145	534,578	53,659	42,134,175	127,037,000	3.02					

[a] Includes also loaders and shot firers.

[b] Owsley and Wayne.

TABLE 97.—*Coal produced in Kentucky, 1922–23*—Continued

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1923												
Eastern district:												
Bell	2, 575, 670	44, 986	38, 630		2, 659, 286	$6, 820, 000	$2. 56	2, 691	1, 362	786	4, 839	140
Boyd	143, 024	5, 840	608		149, 472	298, 000	1. 99	187	53	37	277	207
Breathitt	196, 925	11, 515	700		209, 140	470, 000	2. 25	298	129	81	508	131
Carter	122, 153	25, 430	277		147, 860	369, 000	2. 50	182	93	63	338	160
Clay	180, 583	4, 180	300		185, 063	330, 000	1. 79	197	112	65	374	165
Floyd	2, 968, 898	27, 459	39, 014		3, 035, 371	7, 984, 000	2. 63	2, 475	1, 424	860	4, 759	137
Harlan	8, 268, 535	55, 640	46, 756	210, 179	8, 581, 110	23, 491, 000	2. 74	4, 951	2, 592	1, 737	9, 280	195
Johnson	630, 938	10, 682	17, 691		659, 311	2, 400, 000	3. 64	697	289	186	1, 172	133
Knott	340, 389	2, 796			343, 185	827, 000	2. 41	132	63	42	237	206
Knox	496, 851	4, 133	9, 967		510, 954	1, 474, 000	2. 88	631	256	209	1, 096	133
Laurel	108, 039	353	120		108, 512	257, 000	2. 37	225	74	53	352	126
Lawrence	11, 835				11, 835	21, 000	1. 78	52	24	15	91	48
Lee	58, 526		486		59, 012	138, 000	2. 34	74	35	21	130	129
Letcher	4, 263, 937	50, 931	55, 100		4, 369, 968	12, 527, 000	2. 87	2, 573	1, 243	807	4, 623	167
McCreary	862, 772	14, 587	2, 400		879, 759	2, 246, 000	2. 55	877	374	164	1, 415	142
Martin	412, 560	590	8, 022		421, 172	944, 000	2. 24	200	115	85	400	161
Morgan	25, 088	4, 065	2, 933		32, 086	148, 000	4. 61	105	27	63	195	231
Perry	4, 990, 754	27, 346	3, 933		5, 022, 033	12, 661, 000	2. 52	3, 300	1, 576	1, 032	5, 908	164
Pike	5, 724, 969	69, 915	78, 614	20, 139	5, 893, 637	15, 273, 000	2. 59	3, 474	2, 216	1, 522	7, 212	166
Whitley	471, 538	10, 452	15, 687		497, 677	1, 509, 000	2. 53	846	303	220	1, 369	100
Other counties [b]	2, 310	1, 800			4, 110	11, 000	2. 68	10			10	230
	32, 856, 297	372, 700	321, 238	230, 318	33, 780, 553	90, 198, 000	2. 66	24, 177	12, 360	8, 048	44, 585	161
Western district:												
Christian, Crittenden, and Hancock	31, 284	1, 953	4, 376		37, 613	109, 000	2. 90	181	99	54	334	100
Daviess	98, 152	20, 880	950		119, 982	244, 000	2. 03	99	43	28	170	170
Henderson	284, 894	68, 988	12, 240		366, 122	866, 000	2. 37	399	178	77	654	130
Hopkins	2, 529, 690	140, 455	46, 632		2, 716, 777	5, 437, 000	2. 00	2, 091	871	762	3, 724	124
McLean	65, 011	2, 200	729		67, 940	134, 000	1. 97	165	70	66	301	61
Muhlenberg	3, 728, 624	180, 051	68, 050		3, 976, 725	8, 249, 000	2. 07	3, 580	1, 620	670	5, 870	125
Ohio	943, 993	17, 216	33, 478		994, 687	2, 065, 000	2. 08	1, 152	410	186	1, 748	121
Union	1, 188, 215	30, 496	45, 302		1, 264, 013	2, 874, 000	2. 27	904	406	191	1, 501	171
Webster	1, 317, 317	9, 155	19, 948		1, 346, 420	3, 045, 000	2. 26	1, 163	489	272	1, 924	120
	10, 187, 180	471, 394	231, 705		10, 890, 279	23, 023, 000	2. 11	9, 734	4, 186	2, 306	16, 226	127
All Kentucky	43, 043, 477	844, 094	552, 943	230, 318	44, 670, 832	113, 221, 000	2. 53	33, 911	16, 546	10, 354	60, 811	152
Wagon mines served by rail	106, 485				106, 485	321, 000	3. 01					
Grand total	43, 149, 962	844, 094	552, 943	230, 318	44, 777, 317	113, 542, 000	2. 54					

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[a] Includes also loaders and shot firers.

[b] Owsley and Wayne.

TABLE 98.—*Coal produced in Kentucky, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Eastern district:						
Bell	1, 972, 447	2, 502, 546	1, 695, 350	1, 859, 413	2, 659, 286	+799, 873
Boyd	62, 790	119, 194	42, 730	116, 456	149, 472	+33, 016
Breathitt	137, 442	230, 953	149, 637	294, 711	209, 140	−85, 571
Carter	151, 342	162, 264	68, 181	162, 086	147, 860	−14, 226
Clay	47, 063	108, 970	152, 939	139, 514	185, 063	+45, 549
Floyd	1, 260, 140	1, 716, 504	1, 166, 038	2, 686, 862	3, 035, 371	+348, 409
Harlan	4, 176, 531	5, 057, 131	6, 895, 519	6, 231, 975	8, 581, 110	+2, 349, 135
Johnson	824, 229	797, 240	741, 150	345, 181	659, 311	+314, 130
Knott	----------	----------	(a)	(a)	343, 185	(a)
Knox	583, 128	554, 769	507, 691	450, 361	510, 954	+60, 593
Laurel	74, 478	137, 068	90, 228	162, 235	108, 512	−53, 723
Lawrence	17, 450	21, 500	(a)	45, 705	11, 835	−33, 870
Lee	65, 536	88, 594	32, 913	186, 714	59, 012	−127, 702
Letcher	3, 053, 686	3, 328, 996	2, 500, 694	3, 658, 649	4, 369, 968	+711, 319
McCreary	636, 389	817, 203	611, 846	702, 638	879, 759	+177, 121
Martin	(a)	(a)	65, 715	317, 718	421, 172	+103, 454
Morgan	64, 831	76, 042	38, 009	51, 531	32, 086	−19, 445
Perry	2, 712, 043	3, 130, 959	4, 440, 059	4, 288, 021	5, 022, 033	+734, 012
Pike	4, 784, 899	4, 925, 635	3, 317, 589	5, 671, 572	5, 893, 637	+222, 065
Whitley	632, 012	693, 267	424, 139	343, 720	497, 677	+153, 957
Other counties [a]	36, 146	23, 669	31, 987	216, 937	4, 110	+130, 358
	21, 292, 582	24, 492, 504	22, 972, 414	27, 931, 999	33, 780, 553	+5, 848, 554
Western district:						
Christian	[b] 159, 463	[b] 260, 914	[b] 125, 346	[b] 64, 227	[b] 37, 613	−[b] 26, 614
Daviess	68, 103	94, 273	93, 021	155, 800	119, 982	−35, 818
Hancock	(b)	14, 130	4, 696	(b)	(b)	(b)
Henderson	273, 256	448, 341	340, 720	677, 080	366, 122	−310, 958
Hopkins	2, 463, 010	2, 755, 457	1, 997, 609	3, 476, 788	2, 716, 777	−760, 011
McLean	84, 488	(b)	91, 306	164, 319	67, 940	−96, 379
Muhlenberg	2, 626, 365	3, 822, 695	3, 223, 952	4, 385, 633	3, 976, 725	−408, 908
Ohio	716, 312	992, 036	863, 185	1, 195, 782	994, 687	−201, 095
Union	892, 704	1, 033, 371	821, 300	1, 416, 886	1, 264, 013	−152, 873
Webster	1, 348, 535	1, 615, 041	1, 054, 721	2, 197, 608	1, 346, 420	−851, 188
	8, 632, 236	11, 036, 258	8, 615, 856	13, 734, 123	10, 890, 279	−2, 843, 844
Small mines	111, 243	162, 000	(c)	468, 053	106, 485	−361, 568
Grand total	30, 036, 061	35, 690, 762	31, 588, 270	42, 134, 175	44, 777, 317	+2, 643, 142
Total value	$73, 891, 049	$146, 576, 000	$85, 092, 600	$127, 037, 000	$113, 542, 000	−$13, 495, 000

[a] Martin, Owsley, Pulaski, and Wayne in 1919; Martin, Pulaski, and Wayne in 1920; Knott, Lawrence, and Wayne in 1921; Knott, Owsley, and Wayne in 1922; and Owsley and Wayne in 1923.

[b] Christian and Hancock in 1919; Christian and McLean in 1920; Christian and Crittenden in 1921; and Christian, Crittenden, and Hancock in 1922 and 1923.

[c] No canvass of wagon mines for 1921.

MARYLAND

Although the output of coal in 1923 in Maryland was greater than in the two preceding years, it was less than in any other year since 1882. Much of the State's production is now derived from drawing pillars and stumps in the older workings, and costs of production are therefore comparatively high. Labor difficulties and a poor market played a large part in limiting the output in 1923. The strike of 1922, which began April 1 and was settled in other union districts by Labor Day, dragged on in Maryland far into 1923 and was not officially declared off until November. The mines were in operation 178 days. The increase from 1922 to 1923 was 1,063,219 tons, or 87 per cent; the value increased $2,789,000, or 67.7 per cent.

The average daily tonnage for the years 1918 to 1923 ran the scale from 15,000 tons in 1918 to 3,900 tons in 1922. In 1923 there was a gradual decline from a 9,000-ton average in January to 6,000 tons in December. (See fig. 58.)

TABLE 99.—*Coal produced in Maryland, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
							Underground				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Miners [a]	All others	Surface	Total	
1922											
Allegany	629, 064	31, 983	4, 389	665, 436	$2, 448, 000	$3. 68	1, 825	450	354	2, 629	99
Garrett	506, 718	12, 693	7, 904	527, 315	1, 527, 000	2. 90	738	213	175	1, 126	105
Total, excluding wagon mines	1, 135, 782	44, 676	12, 293	1, 192, 751	3, 975, 000	3. 31	2, 563	663	529	3, 755	101
Wagon mines served by rail	29, 956			29, 956	147, 000	4. 90					
Grand total	1, 165, 738	44, 676	12, 293	1, 222, 707	4, 122, 000	3. 37					
1923											
Allegany	1, 433, 420	62, 512	11, 733	1, 507, 665	4, 852, 000	3. 21	1, 563	551	366	2, 480	198
Garrett	725, 619	15, 311	14, 682	755, 612	1, 976, 000	2. 62	797	263	185	1, 245	137
Total, excluding wagon mines	2, 159, 039	77, 823	26, 415	2, 263, 277	6, 828, 000	3. 02	2, 360	814	551	3, 725	178
Wagon mines served by rail	22, 649			22, 649	83, 000	3. 66					
Grand total	2, 181, 688	77, 823	26, 415	2, 285, 926	6, 911, 000	3. 02					

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[a] Includes also loaders and shot firers.

TABLE 100.—*Coal produced in Maryland, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Allegany	2, 195, 724	3, 008, 728	1, 497, 077	665, 436	1, 507, 665	+842, 229
Garrett	818, 564	1, 021, 511	330, 663	527, 315	755, 612	+228, 297
Small mines	7, 398	35, 000	([a])	29, 956	22, 649	−7, 307
	3, 021, 686	4, 065, 239	1, 827, 740	1, 222, 707	2, 285, 926	+1, 063, 219
Total value	$8, 255, 984	$18, 815, 000	$6, 602, 000	$4, 122, 000	$6, 911, 000	+$2, 789, 000

[a] No canvass of wagon mines for 1921.

MICHIGAN

Coal production in Michigan in 1923 recovered promptly from the low mark caused by the strike of the preceding year, the gain being 242,685 tons, or 26.1 per cent, in quantity and $852,000, or 18.2 per cent, in value. The mines were in operation more days, though employing fewer men to take out the coal. The daily output per man was very nearly the same for the two years—2.65 tons in 1922 and 2.67 tons in 1923.

TABLE 101.—*Coal produced in Michigan, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Underground		Surface	Total	
							Miners [a]	All others			
1922											
Bay and Calhoun	283, 067	5, 443	11, 644	300, 154	$1, 506, 000	$5. 02	496	234	76	806	162
Saginaw	572, 850	8, 371	48, 015	629, 236	3, 187, 000	5. 06	839	405	116	1, 360	162
	855, 917	13, 814	59, 659	929, 390	4, 693, 000	5. 05	1, 335	639	192	2, 166	162
1923											
Bay	384, 669	3, 992	15, 342	404, 003	1, 927, 000	4. 77	485	246	79	810	231
Calhoun and Shiawassee	23, 250	2, 500		25, 750	92, 500	3. 59	8	34	4	46	97
Saginaw	678, 129	9, 743	54, 300	742, 172	3, 525, 000	4. 75	720	300	101	1, 121	220
Total, excluding wagon mines	1, 086, 048	16, 235	69, 642	1, 171, 925	5, 544, 500	4. 73	1, 213	580	184	1, 977	222
Wagon mines served by rail	150			150	500	3. 33					
Grand total	1, 086, 198	16, 235	69, 642	1, 172, 075	5, 545, 000	4. 73					

[a] Includes also loaders and shot firers.

TABLE 102.—*Coal produced in Michigan, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase, 1923
Bay	358,869	449,687	348,495	[a] 300,154	404,003	[a] 129,599
Saginaw	581,935	935,048	746,237	629,236	742,172	112,936
Other counties	[b] 55,195	[b] 103,030	[b] 46,983	([b])	[b] 25,750	([a])
Small mines	546	2,000	([c])	------	150	150
	996,545	1,489,765	1,141,715	929,390	1,172,075	242,685
Total value	$3,864,228	$7,346,000	$5,555,000	$4,693,000	$5,545,000	$852,000

[a] Bay includes Tuscola in 1922, and Calhoun and Shiawassee increase in 1923.

[b] Calhoun and Tuscola in 1919, 1920, and 1921; Tuscola only, and included with Bay in 1922; Calhoun and Shiawassee in 1923.

[c] No canvass of wagon mines for 1921.

MISSOURI

Like Kansas, Missouri showed an increased production of coal in 1923, as compared with 1922, and yet a smaller tonnage than for many years preceding 1922. Not since 1910 has the output in this State been as low as in 1922 and 1923. The output for 1923 was 3,403,151 tons, an increase of 478,401 tons, or 16.4 per cent. The total value was $11,575,000, and the average value per ton was $3.40, an increase in the former of $422,000, but a decrease in the latter.

Figure 49 shows the course of daily production in the State, by years from 1918 to 1922 and by months for 1923. The general curve practically follows that of Kansas and Oklahoma, though varying somewhat in the first and last months of 1923. The average daily output in 1918 was 18,000 tons; in 1922 it was 9,500 tons. The year 1923 began with an average of 14,500 tons in January and ended with 11,500 tons in December.

TABLE 103.—*Coal produced in Missouri, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
							Underground				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Miners [a]	All others	Surface	Total	
1922											
Adair	202,586	15,088	4,029	221,703	$728,000	$3.28	720	299	58	1,077	86
Audrain	6,065	11,347	114	17,526	73,000	4.16	29	11	3	43	252
Barton	620,292	6,343	31,457	658,092	2,441,000	3.71	106	26	711	843	89
Bates	143,334	1,153	2,560	147,047	453,000	3.08	132	30	78	240	129
Boone, Chariton, and Moniteau	1,890	11,367	300	13,557	38,000	2.80	27	6	10	43	214
Caldwell, Clay, Dade, and Platte	71,958	13,138	3,017	88,113	458,000	5.20	221	105	33	359	155
Callaway	5,115	35,368	772	41,255	170,000	4.12	111	16	37	164	159
Grundy, Harrison, and Schuyler	4,152	8,763	344	13,259	68,000	5.13	82	15	6	103	128
Henry	110,384	3,506	1,484	115,374	392,000	3.40	14	6	110	130	161
Johnson	41,549	1,792	860	44,201	170,000	3.84	60	14	33	107	113
Lafayette	371,330	27,287	17,766	416,383	1,678,000	4.03	1,011	454	122	1,587	121
Linn	32,637	20,776	394	53,807	255,000	4.74	184	85	17	286	104
Macon	330,511	16,281	5,345	352,137	1,257,000	3.57	827	177	71	1,075	105
Randolph	144,998	9,622	4,072	158,692	612,000	3.86	564	143	45	752	93
Ray	376,642	43,839	3,400	423,881	1,774,000	4.19	1,188	430	113	1,731	123
Vernon	28,440	1,881	327	30,648	106,000	3.46	66	18	15	99	92
Other counties [b]	52,773	776	108	53,657	178,000	3.22	28	13	70	111	151
Total, excluding wagon mines	2,544,656	228,327	76,349	2,849,332	10,851,000	3.81	5,370	1,848	1,532	8,750	113
Wagon mines served by rail	75,418			75,418	302,000	4.00					
Grand total	2,620,074	228,327	76,349	2,924,750	11,153,000	3.81					
1923											
Adair	238,846	5,883	7,054	251,783	744,000	2.96	369	116	49	534	160
Audrain	5,558	10,314	87	15,959	62,000	3.88	38	14	6	58	263
Barton	658,822	6,913	38,355	704,090	2,221,000	3.15	87	14	693	794	93
Bates	114,245	1,839	3,850	119,934	318,000	2.65	99	23	96	218	130
Boone and Chariton		12,150	50	12,200	38,000	3.11	32	8	6	46	223
Caldwell, Clay, Dade, and Platte	60,517	32,277	2,498	95,292	358,000	3.76	189	54	22	265	217
Callaway	6,800	19,602	200	26,602	110,000	4.13	46	14	7	67	202
Grundy, Harrison, and Schuyler	3,284	8,426	500	12,210	66,000	5.41	51	12	5	68	133
Henry	107,600	5,669	1,825	115,094	318,000	2.76	19	3	95	117	170

Johnson	56, 075	1, 458	967	58, 500	206, 000	3. 52	49	20	30	99	181
Lafayette	470, 938	23, 796	16, 543	511, 277	1, 985, 000	3. 88	757	303	101	1, 161	187
Linn	5, 126	22, 674	164	27, 964	150, 000	5. 36	140	66	19	225	76
Macon	550, 348	10, 909	10, 093	571, 350	1, 767, 000	3. 09	764	223	64	1, 051	192
Putnam	12, 869			12, 869	48, 000	3. 71	85	24	11	120	363
Randolph	222, 612	6, 517	4, 400	233, 529	796, 000	3. 41	306	70	38	414	196
Ray	474, 054	41, 110	3, 469	518, 633	2, 048, 000	3. 95	1, 126	357	109	1, 592	136
Vernon	7, 478	212	134	7, 824	21, 000	2. 68	35	8	9	52	40
Other counties [c]	17, 164	1, 698	240	19, 102	52, 000	2. 72	25	6	40	71	135
Total, excluding wagon mines	3, 012, 336	211, 447	90, 429	3, 314, 212	11, 308, 000	3. 41	4, 217	1, 335	1, 400	6, 952	155
Wagon mines served by rail	88, 939			88, 939	267, 000	3. 00					
Grand total	3, 101, 275	211, 447	90, 429	3, 403, 151	11, 575, 000	3. 40					

[a] Include also loaders and shot firers.

[b] Franklin, Lincoln, Putnam, Ralls, and St. Clair.

[c] Cass, Lincoln, Ralls, and St. Clair.

TABLE 104.—*Coal produced in Missouri, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Adair	517, 910	777, 986	527, 804	221, 703	251, 783	+30, 080
Audrain	16, 683	18, 626	10, 538	17, 526	15, 959	−1, 567
Barton	887, 174	965, 757	726, 347	658, 092	704, 090	+45, 998
Bates	57, 050	115, 621	39, 690	147, 047	119, 934	−27, 113
Boone	18, 416	18, 950	16, 128	([a])	[a] 12, 200	−[a] 1, 357
Caldwell, Clay, and Platte	68, 119	86, 617	[b] 91, 646	[b] 88, 113	[b] 95, 292	+[b] 7, 179
Callaway	51, 010	58, 462	32, 191	41, 255	26, 602	−14, 653
Cooper, etc. [c]	21, 970	29, 300	4, 514	13, 557	------------	([a])
Dade	6, 324	6, 342	([b])	([b])	([b])	([b])
Grundy and Harrison	31, 728	23, 080	[e] 11, 654	[d] 13, 259	[d] 12, 210	−1, 049
Henry	136, 872	203, 200	95, 279	115, 374	115, 094	−280
Johnson	77, 958	45, 434	15, 240	44, 201	58, 500	+14, 299
Lafayette	651, 193	885, 569	540, 421	416, 383	511, 277	+94, 894
Linn	99, 991	142, 290	89, 747	53, 807	27, 964	−25, 843
Macon	384, 846	720, 227	473, 985	352, 137	571, 350	+219, 213
Putnam	37, 973	30, 867	13, 921	([e])	12, 869	([e])
Randolph	320, 835	422, 903	324, 836	158, 692	233, 529	+74, 837
Ray	408, 148	578, 694	476, 117	423, 881	518, 633	+94, 752
Vernon	47, 978	74, 771	42, 026	30, 648	7, 824	−22, 824
Other counties [f]	72, 475	61, 869	19, 537	53, 657	19, 102	−21, 686
Small mines	65, 145	103, 000	([g])	75, 418	88, 939	+13, 521
	3, 979, 798	5, 369, 565	3, 551, 621	2, 924, 750	3, 403, 151	+478, 401
Total value	$12, 766, 366	$22, 230, 000	$13, 915, 500	$11, 153, 000	$11, 575, 000	+$422, 000

[a] Included under "Cooper, etc.," 1922; includes Chariton in 1923 and Cooper, etc., decrease in 1923.

[b] Caldwell, etc., includes Dade in 1921, 1922, and 1923.

[c] Cooper, Howard, Moniteau, and Pettis in 1919; Cooper, Howard, Moniteau, Morgan, and Pettis in 1920; Howard, Moniteau, and Pettis in 1921; Boone, Chariton, and Moniteau in 1922; no production in Cooper in 1922 and 1923.

[d] Includes Schuyler in 1922 and 1923.

[e] Included under "Other counties."

[f] Other counties include Chariton, Franklin, Ralls, and St. Clair in 1919; Chariton, Ralls, and St. Clair in 1920; Chariton, Franklin, Ralls, and St. Clair in 1921; Franklin, Lincoln, Putnam, Ralls, and St. Clair in 1922; and Cass, Lincoln, Ralls, and St. Clair in 1923.

[g] No canvass of wagon mines for 1921.

MONTANA

The year 1923 in the Montana coal fields showed a large increase over the record of the strike year 1922—575,457 tons, or 22.4 per cent, more coal being raised. Although the average value per ton decreased, the total value showed a gain of $1,443,500, or 17.6 per cent. The mines were in operation more days but employed fewer men than in the preceding year.

The curve of average daily output (fig. 51) shows the summer depression characteristic of the northwestern States, with an abnormal drop in December.

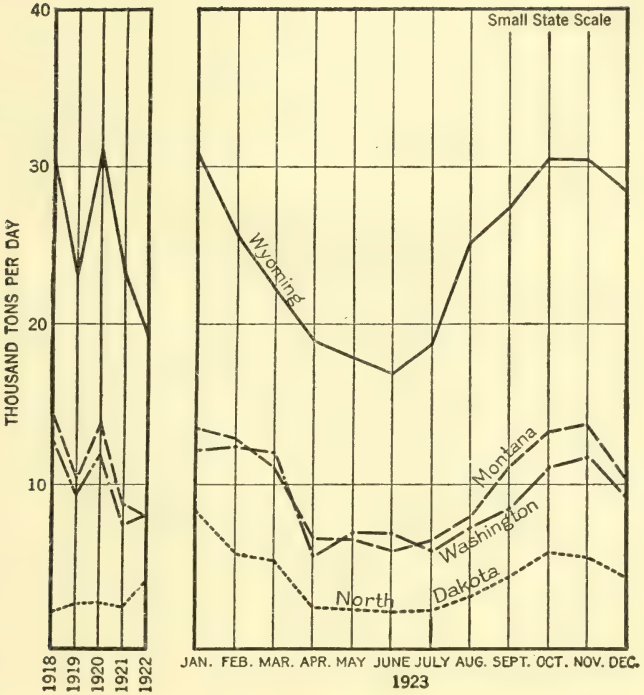

FIGURE 51.—Production of coal per working day in Montana, North Dakota, Washington, and Wyoming, 1918–1923. Data from Table 78

TABLE 105.—*Coal produced in Montana, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
							Underground		Surface	Total	
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Miners [a]	All others			
1922											
Blaine	2,000	11,261	173	13,434	$47,000	$3.50	14	6	7	27	178
Carbon	958,206	28,099	57,917	1,044,222	3,682,000	3.53	941	377	286	1,604	143
Cascade	638,233	17,791	13,889	669,913	1,912,000	2.85	537	211	128	876	144
Hill	5,024	8,714		13,738	43,000	3.15	16	2	2	20	198
Musselshell	762,122	6,313	7,342	775,777	2,343,000	3.02	627	296	106	1,029	127
Sheridan	950	8,136		9,086	19,000	2.09	16			16	172
Other counties [b]	13,725	12,099	5,396	31,220	104,500	3.35	43	12	8	63	176
Total, excluding wagon mines	2,380,260	92,413	84,717	2,557,390	8,150,500	3.19	2,194	904	537	3,635	140
Wagon mines served by rail	14,831			14,831	58,000	3.90					
Grand total	2,395,091	92,413	84,717	2,572,221	8,208,500	3.19					
1923											
Blaine	1,702	14,225	150	16,077	39,000	2.43	15	4	4	23	225
Carbon	1,258,107	35,988	72,875	1,366,970	4,641,000	3.40	858	382	274	1,514	196
Cascade	662,170	31,957	11,402	705,529	1,969,000	2.79	507	201	133	841	168
Musselshell	993,747	6,329	10,362	1,010,438	2,855,000	2.83	609	312	129	1,050	163
Sheridan	200	8,534		8,734	30,000	3.43	15			15	179
Other counties [c]	15,572	21,027		36,599	108,000	2.95	50	11	7	68	207
Total, excluding wagon mines	2,931,498	118,060	94,789	3,144,347	9,642,000	3.07	2,054	910	547	3,511	179
Wagon mines served by rail	3,331			3,331	10,000	2.92					
Grand total	2,934,829	118,060	94,789	3,147,678	9,652,000	3.07					

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[a] Includes also loaders and shot firers.

[b] Chouteau, Gallatin, Pondera, Richland, Roosevelt, and Toole.

[c] Chouteau, Gallatin, Hill, Pondera, Richland, Roosevelt, and Toole.

TABLE 106.—*Coal produced in Montana, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Blaine	8, 722	9, 240	(a)	13, 434	16, 077	+2, 643
Carbon	1, 311, 130	1, 814, 486	1, 315, 722	1, 044, 222	1, 366, 970	+322, 748
Cascade	724, 403	983, 885	686, 446	669, 913	705, 529	+35, 616
Hill	20, 148	17, 936	9, 030	13, 738	(a)	(a)
Musselshell	865, 907	1, 140, 423	662, 087	775, 777	1, 010, 438	+234, 661
Roosevelt	4, 774	3, 000	2, 200	(a)	(a)	(a)
Sheridan	30, 643	19, 623	9, 104	9, 086	8, 734	−352
Other counties [a]	250, 788	415, 273	49, 369	31, 220	36, 599	−8, 359
Small mines	[b] 19, 854	10, 000	(c)	14, 831	3, 331	−11, 500
	3, 236, 369	4, 413, 866	2, 733, 958	2, 572, 221	3, 147, 678	+575, 457
Total value	$8, 208, 500	$13, 923, 000	$8, 921, 600	$8, 208, 500	$9, 652, 000	+$1, 443, 500

[a] Carter, Chouteau, Dawson, Fergus, Gallatin, Pondera, and Richland in 1919; Carter, Chouteau, Dawson, Fergus, Golden Valley, Judith Basin, Park, Pondera, Richland, and Toole in 1920; Blaine, Carter, Chouteau, Gallatin, Judith Basin, Park, Pondera, Richland, and Toole in 1921; Chouteau, Gallatin, Pondera, Richland, Roosevelt, and Toole in 1922; and Chouteau, Gallatin, Hill, Pondera, Richland, Roosevelt, and Toole in 1923.

[b] Includes Toole.

[c] No canvass of wagon mines for 1921.

NEW MEXICO

Only two States of any importance produced less coal in 1923 than in 1922; New Mexico was one of them, and Utah the other. Neither was greatly affected by the strike of 1922, and both felt the competition of fuel oil in 1923. The output in New Mexico was 2,915,173 tons, as compared with 3,147,173 tons in 1922, a loss of 232,000 tons, or 7.4 per cent, although the number of employees was slightly greater—4,095, against 4,001—and the number of days worked was 216 in both years. The value of the coal produced was $10,668,000, a decrease of $309,000, or 2.8 per cent, in comparison with that of 1922.

In Figure 46 the curve of production in tons per day is shown for the years 1918 to 1922 and for the twelve months of 1923.

TABLE 107.—*Coal produced in New Mexico, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1922												
Colfax	1,970,175	18,610	11,394	182,339	2,182,518	$7,093,000	$3.25	1,308	561	426	2,295	208
McKinley	625,926	8,417	31,519	----------	665,862	2,493,000	3.75	578	289	218	1,085	213
Rio Arriba	27,244	262	480	----------	27,986	81,000	2.89	34	6	11	51	221
Other counties [b]	216,637	8,642	14,086	----------	239,365	1,181,000	4.93	333	113	124	570	256
Total, excluding wagon mines	2,839,982	35,931	57,479	182,339	3,115,731	10,348,000	3.48	2,253	969	779	4,001	216
Wagon mines served by rail	31,442	----------	----------	----------	31,442	129,000	4.10	----------	----------	----------	----------	----------
Grand total	2,871,424	35,931	57,479	182,339	3,147,173	10,977,000	3.49	----------	----------	----------	----------	----------
1923												
Colfax	1,514,968	17,305	6,430	257,335	1,796,038	6,334,000	3.53	1,408	623	281	2,312	203
McKinley	783,687	10,482	27,246	----------	821,415	2,996,000	3.65	766	270	183	1,219	225
Rio Arriba	32,032	87	1,100	----------	33,219	98,000	2.95	41	9	6	56	289
San Juan	88	3,972	----------	----------	4,060	9,000	2.22	6	1	1	8	185
Other counties [c]	224,951	6,838	11,913	----------	243,702	1,179,000	4.84	301	122	77	500	246
Total, excluding wagon mines	2,555,726	38,684	46,689	257,335	2,898,434	10,616,000	3.66	2,522	1,025	548	4,095	216
Wagon mines served by rail	16,739	----------	----------	----------	16,739	52,000	3.11	----------	----------	----------	----------	----------
Grand total	2,572,465	38,684	46,689	257,335	2,915,173	10,668,000	3.66	----------	----------	----------	----------	----------

[a] Includes also loaders and shot firers.
[b] Lincoln, San Juan, Santa Fe, and Socorro.
[c] Lincoln, Santa Fe, and Socorro.

TABLE 108.—*Coal produced in New Mexico, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Colfax	2, 171, 531	2, 556, 919	1, 714, 851	2, 182, 518	1, 796, 038	−386, 480
Lincoln, Santa Fe, and Socorro	219, 775	274, 141	[a] 203, 270	[a] 239, 365	243, 702	+[a] 8, 397
McKinley	728, 332	832, 202	514, 645	665, 862	821, 415	+155, 553
Rio Arriba	13, 250	17, 186	20, 716	27, 986	33, 219	+5, 233
San Juan	3, 949	2, 992	(a)	(a)	4, 060	(a)
Small mines	1, 919	------------	(b)	31, 442	16, 739	−14, 703
	3, 138, 756	3, 683, 440	2, 453, 482	3, 147, 173	2, 915, 173	−232, 000
Total value	$9, 750, 833	$13, 568, 000	$9, 585, 000	$10, 977, 000	$10, 668, 000	−$309, 000

[a] San Juan included with Lincoln in 1921 and 1922.
[b] No general canvass of wagon mines for 1921.

NORTH CAROLINA

North Carolina has been listed as a coal-producing State at intervals since 1840, and its maximum production was reached in 1922, when 78,570 tons was recorded In 1923 only 36,019 tons was raised, and the value decreased from $388,000 to $132,000.

NORTH DAKOTA

North Dakota was one of those States which again broke all coal-production records in 1923, though the rate of increase over 1922 was not large—4.4 per cent—and the value declined nearly 7 per cent. The output, all lignite, was 1,385,400 tons, valued at $3,275,000. This larger output was achieved by working the mines more days, for the total number of employees was less than in the preceding year.

The daily output for the working year was about 4,500 tons in 1923, a higher average than for any other year, and ranged from 8,400 tons in January to 2,300 tons in June and 4,500 tons in December. (See fig. 51.) For the year 1918 the average was 2,300 tons; for 1922, 4,300 tons.

TABLE 109.—*Lignite produced in North Dakota, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Underground		Surface	Total	
							Miners [a]	All others			
1922											
Adams	75,224	4,930	925	81,079	$218,000	$2.69	54	17	27	98	203
Billings	34,797	11,347		46,144	118,000	2.56	26	8	12	46	208
Burke	206,079	25,822	7,761	239,662	605,000	2.52	10	3	132	145	189
Burleigh	245,788	13,865	6,525	266,178	761,000	2.86	179	59	55	293	164
Divide	46,925	5,733	19	52,677	139,000	2.63	37	9	9	55	212
Dunn	20,700	3,300	1,040	25,040	55,000	2.18	32	10	10	52	121
Grant	15,700	3,500		19,200	36,000	1.86	11	5	3	19	137
Hettinger	13,563	12,169	75	25,807	70,000	2.73	21	6	8	35	168
McLean	65,066	29,665	1,100	95,831	285,000	2.98	148	44	66	258	156
Mercer	124,304	360	10,635	135,299	366,000	2.71	84	65	107	256	158
Morton	25,000	24,391	2,000	51,391	98,000	1.89	37	9	20	66	228
Stark	44,875	8,913	4,355	58,143	144,000	2.48	35	12	18	65	239
Ward	22,915	26,592	31	49,538	131,000	2.64	60	16	17	93	141
Williams	50,834	36,189	116	87,139	231,000	2.65	95	21	20	136	183
Other counties [b]	26,505	4,417	3,650	34,572	76,000	2.20	17	6	8	31	224
Total, excluding wagon mines	1,018,275	211,193	38,232	1,267,700	3,333,000	2.63	846	290	512	1,648	175
Wagon mines served by rail	59,864			59,864	180,000	3.00					
Grand total	1,078,139	211,193	38,232	1,327,564	3,513,000	2.65					
1923											
Adams	66,253	6,035	3,426	75,714	184,000	2.43	62	16	16	94	154
Burke	217,561	12,289	9,480	239,330	532,000	2.22	14	7	124	145	214
Burleigh	221,633	13,191	8,862	243,686	589,000	2.42	174	67	47	288	163
Divide	44,586	5,575		50,161	122,000	2.43	28	8	15	51	184
Dunn	10,771	3,756		14,527	29,000	1.99	14	3	6	23	184
Grant	5,035	5,139		10,174	22,000	2.16	29	6	7	42	126
Hettinger	8,699	7,314	200	16,213	35,000	2.16	32	8	9	49	119
McLean	85,725	31,779	2,688	120,192	293,000	2.43	75	16	73	164	206
Mercer	209,627	2,950	7,580	220,157	534,000	2.43	96	40	93	229	182
Morton	35,117	30,517	400	66,034	131,000	1.98	47	13	18	78	184
Mountrail		1,722		1,722	3,000	1.74	20			20	170
Stark	49,523	17,615	2,523	69,661	168,000	2.41	50	23	20	93	216
Ward	37,664	36,585	71	74,320	188,000	2.53	109	16	18	143	193
Williams	43,254	38,006	278	81,538	205,000	2.52	81	24	17	122	167
Other counties [c]	64,424	6,101	3,000	73,525	176,000	2.39	52	10	18	80	236
Total, excluding wagon mines	1,099,872	218,574	38,508	1,356,954	3,211,000	2.37	883	257	481	1,621	182
Wagon mines served by rail	28,446			28,446	64,000	2.25					
Grand total	1,128,318	218,574	38,508	1,385,400	3,275,000	2.36					

[a] Includes also loaders and shot firers.

[b] Bowman and Oliver.

[c] Billings, Bowman, and Oliver.

TABLE 110.—*Lignite produced in North Dakota, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Adams	39, 123	([a])	([a])	81, 079	75, 714	−5, 365
Billings	31, 940	47, 779	33, 339	46, 144	([a])	([a])
Burke	61, 180	99, 193	123, 722	239, 662	239, 330	— 332
Burleigh	[b] 323, 084	254, 741	237, 424	266, 178	243, 686	−22, 492
Divide	33, 902	37, 142	37, 884	52, 677	50, 161	−2, 516
Dunn	4, 600	([a])	([a])	25, 040	14, 527	−10, 513
Grant				19, 200	10, 174	−9, 026
Hettinger	12, 785	13, 433	([a])	25, 807	16, 213	−9, 594
McLean	26, 437	32, 302	20, 669	95, 831	120, 192	+24, 361
Mercer	([b])	107, 587	129, 908	135, 299	220, 157	+84, 858
Morton	28, 991	30, 942	29, 851	51, 391	66, 034	+14, 643
Mountrail					1, 722	+1, 722
Stark	68, 429	64, 114	42, 704	58, 143	69, 661	+11, 518
Ward	93, 179	86, 404	58, 603	49, 538	74, 320	+24, 782
Williams	66, 648	73, 744	52, 992	87, 139	81, 538	−5, 601
Other counties [a]	8, 584	60, 244	97, 807	34, 572	73, 525	−7, 191
Small mines	42, 077	41, 000	([c])	59, 864	28, 446	−31, 418
	840, 959	948, 625	864, 903	1, 327, 564	1, 385, 400	+57, 836
Total value	$2, 100, 303	$2, 724, 000	$2, 329, 500	$3, 513, 000	$3, 275, 000	−$238, 000

[a] Bowman, Golden Valley, and Oliver in 1919; Adams, Bowman, Dunn, Golden Valley, and Oliver in 1920; Adams, Bowman, Dunn, Hettinger, and Oliver in 1921; Bowman and Oliver in 1922; and Billings, Bowman, and Oliver in 1923.

[b] Burleigh includes Mercer in 1919.

[c] No canvass of wagon mines for 1921

OHIO

Ohio rallied in 1923 and produced more coal than in any previous year with the exception of 1917, 1918, and 1920. All the counties of any importance showed increases over 1922, and the gain for the State as a whole was 13,592,652 tons, or 50.4 per cent. Only two other States exceeded this rate of increase in 1923—Maryland and Pennsylvania—and no others approached it. The output amounted to 40,546,443 tons, and the value was $98,610,000, a gain over 1922 of $11,554,000, or 13.3 per cent.

The number of employees was very nearly the same in the two years, but the days worked, like the tonnage, increased 50 per cent. Even this was the equivalent of only half a years' potential working days.

The average daily output for a number of years and for the months of 1923 is shown in the accompanying diagram (fig. 52). In 1923 the range was from 148,000 tons in June to about 100,000 tons in December. The maximum monthly average did not equal the average for the entire year 1920.

Spot prices in Ohio, as elsewhere, were declining in 1923. By December southern Ohio mine-run coal was quoted by Coal Age at $1.70 f. o. b. mines, and Pittsburgh No. 8 mine run at $1.91.

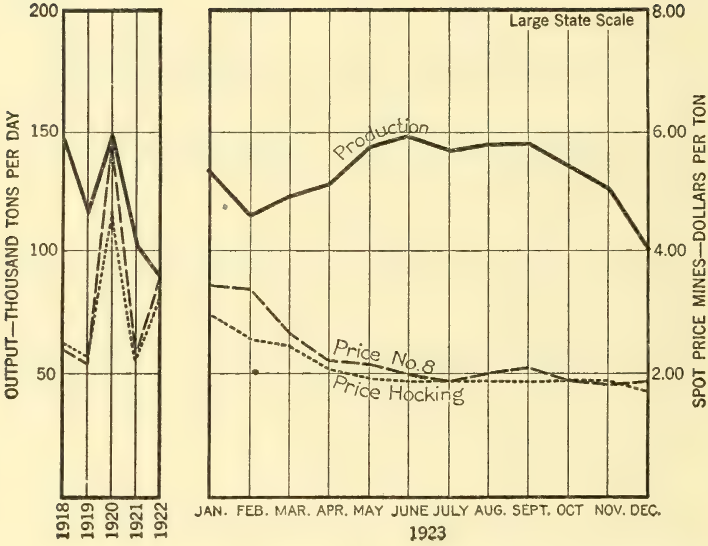

FIGURE 52.—Production of coal per working day in Ohio and trend of spot prices, run-of-mine grade, in No. 8 and Hocking districts, 1918–1923. Data from Tables 78 and 79; spot prices as quoted by Coal Age

TABLE 111.—*Coal produced in Ohio, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
							Underground				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Miners [a]	All others	Surface	Total	
1922											
Athens	3,165,029	71,354	59,306	3,295,689	$11,023,000	$3.35	5,529	1,791	875	8,195	83
Belmont	6,410,013	271,793	78,011	6,759,817	20,756,000	3.07	8,528	2,653	1,402	12,583	100
Carroll	246,405	70,509	17,726	334,640	1,042,000	3.11	384	142	73	599	170
Columbiana	561,635	44,716	29,187	635,538	2,111,000	3.32	736	308	221	1,265	138
Coshocton	184,786	22,343	2,002	209,131	714,000	3.41	419	136	76	631	93
Gallia, Morgan, Scioto, and Washington	171,868	4,219	1,959	178,046	590,000	3.31	273	126	45	444	108
Guernsey	1,905,804	86,034	84,269	2,076,107	6,414,000	3.09	2,756	1,240	372	4,368	90
Harrison	2,073,497	13,272	56,496	2,143,265	6,527,000	3.05	1,009	458	1,025	2,492	117
Hocking	825,227	22,694	20,718	868,639	2,935,000	3.38	1,650	494	385	2,529	68
Holmes	1,895	2,793		4,688	14,000	3.01	13	1	1	15	147
Jackson	238,667	26,595	5,516	270,778	951,000	3.51	789	281	149	1,219	81
Jefferson	3,871,798	552,814	71,961	4,496,573	15,320,000	3.41	3,847	1,387	1,524	6,758	127
Lawrence	85,984	96,240	575	182,799	515,000	2.82	347	73	51	471	119
Mahoning	4,642	49,034	120	53,796	193,000	3.59	77	10	8	95	224
Medina		9,682		9,682	55,000	5.72	20	6	3	29	90
Meigs	598,605	18,591	26,656	643,852	2,402,000	3.73	1,575	588	332	2,495	68
Muskingum	288,605	64,765	2,743	356,113	1,135,000	3.19	543	120	140	803	102
Noble	319,037	5,900	12,921	337,858	1,098,000	3.25	571	316	80	967	79
Perry	1,696,320	32,569	29,587	1,758,476	5,685,000	3.23	2,615	859	796	4,270	84
Portage and Wayne	50,052	12,195	8,265	70,512	304,000	4.31	102	42	30	174	125
Stark	156,378	249,282	14,465	420,125	1,338,000	3.18	446	114	87	647	201
Summit		17,339	1,704	19,043	73,000	3.84	41	15	13	69	83
Tuscarawas	1,167,293	206,059	38,851	1,412,203	4,189,000	2.97	1,520	500	488	2,508	123
Vinton	102,407	2,430	3,040	107,877	336,000	3.11	344	112	112	568	64
Total, excluding wagon mines	24,125,947	1,953,222	566,078	26,645,247	85,720,000	3.22	34,134	11,772	8,288	54,194	100
Wagon mines served by rail	308,544			308,544	1,336,000	4.33					
Grand total	24,434,491	1,953,222	566,078	26,953,791	87,056,000	3.23					

[a] Includes also loaders and shot firers.

TABLE 111.—*Coal produced in Ohio, 1922-23*—Continued

County	Net tons				Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Underground		Surface	Total	
							Miners [a]	All others			
1923											
Athens	4,133,625	76,744	74,959	4,285,328	$10,315,000	$2.41	5,765	1,786	930	8,481	109
Belmont	12,689,439	406,506	99,185	13,195,130	31,100,000	2.36	8,327	3,076	1,390	12,793	193
Carroll	353,394	85,172	20,496	459,062	1,204,000	2.62	362	129	64	555	202
Columbiana	863,307	55,169	23,266	941,742	2,747,000	2.92	686	241	241	1,168	187
Coshocton	213,433	14,464	3,179	231,076	655,000	2.83	404	143	76	623	103
Guernsey	3,070,277	167,833	81,127	3,319,237	8,240,000	2.48	2,784	1,246	391	4,421	144
Harrison	2,695,323	17,249	53,382	2,765,954	6,168,000	2.23	1,220	424	1,032	2,676	145
Hocking	1,016,931	72,235	9,481	1,098,647	2,688,000	2.44	1,753	459	302	2,514	98
Holmes	250	2,725	----------	2,975	8,000	2.81	8	----------	----------	8	148
Jackson	194,413	59,636	11,397	265,446	840,000	3.15	777	285	157	1,219	66
Jefferson	5,739,482	691,365	76,163	6,507,010	16,069,000	2.47	3,769	1,568	1,559	6,896	188
Lawrence	25,665	114,783	343	140,791	348,000	2.47	269	71	42	382	121
Mahoning	476	46,874	12	47,362	174,000	3.67	65	10	7	82	190
Medina	----------	10,485	400	10,885	61,000	5.60	15	4	3	22	235
Meigs	1,166,420	26,926	23,983	1,217,329	3,141,000	2.57	1,847	694	333	2,874	114
Morgan, Scioto, and Washington	211,559	3,552	3,745	218,856	530,000	2.42	283	103	49	435	126
Muskingum	411,826	65,205	3,594	480,625	1,121,000	2.33	537	123	170	830	141
Noble	690,169	9,482	19,269	718,920	1,798,000	2.50	513	308	83	904	156
Perry	2,430,799	53,419	54,733	2,538,951	5,762,000	2.27	2,519	777	797	4,093	122
Portage, Summit, and Wayne	80,027	21,624	16,803	118,454	475,000	4.01	136	50	43	229	159
Stark	127,185	311,249	5,128	443,562	1,345,000	3.03	406	109	74	589	206
Tuscarawas	977,253	356,332	16,739	1,350,324	3,311,000	2.45	1,382	507	382	2,271	131
Vinton	90,965	3,239	2,905	97,109	238,000	2.45	294	112	84	490	81
Total, excluding wagon mines	37,182,218	2,672,268	600,289	40,454,775	98,338,000	2.43	34,121	12,225	8,209	54,555	150
Wagon mines served by rail	91,668	----------	----------	91,668	272,000	2.97	----------	----------	----------	----------	----------
Grand total	37,273,886	2,672,268	600,289	40,546,443	98,610,000	2.43	----------	----------	----------	----------	----------

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[a] Includes also loaders and shot firers.

TABLE 112.—*Coal produced in Ohio, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Athens	4, 840, 913	6, 501, 013	3, 836, 590	3, 295, 689	4, 285, 328	+989, 639
Belmont	10, 101, 682	11, 192, 785	11, 601, 150	6, 759, 817	13, 195, 130	+6, 435, 313
Carroll	344, 626	502, 346	265, 623	334, 640	459, 062	+124, 422
Columbiana	634, 411	857, 192	604, 728	635, 538	941, 742	+306, 204
Coshocton	284, 790	443, 170	207, 166	209, 131	231, 076	+21, 945
Gallia	7, 688	12, 274	[a] 205, 641	[a] 178, 046	------------	([b])
Guernsey	3, 334, 973	3, 733, 810	2, 982, 155	2, 076, 107	3, 319, 237	+1, 243, 130
Harrison	1, 427, 972	2, 002, 585	1, 635, 430	2, 143, 265	2, 765, 954	+622, 689
Hocking	1, 575, 622	2, 198, 998	869, 870	868, 639	1, 098, 647	+230, 008
Holmes	8, 594	9, 780	4, 535	4, 688	2, 975	−1, 713
Jackson	492, 110	834, 856	178, 603	270, 778	265, 446	−5, 332
Jefferson	5, 030, 419	6, 243, 200	4, 353, 870	4, 496, 573	6, 507, 010	+2, 010, 437
Lawrence	141, 414	301, 284	57, 569	182, 799	140, 791	−42, 008
Mahoning	50, 681	62, 001	36, 123	53, 796	47, 362	−6, 434
Medina	4, 899	6, 651	3, 184	9, 682	10, 885	+1, 203
Meigs	897, 573	1, 509, 837	932, 035	643, 852	1, 217, 329	+573, 477
Morgan	[b] 212, 351	[b] 286, 296	([a])	([a])	[b] 218, 856	+[b]40, 810
Muskingum	431, 235	653, 056	185, 475	356, 113	480, 625	+124, 512
Noble	809, 198	668, 089	538, 971	337, 858	718, 920	+381, 062
Perry	2, 519, 050	3, 651, 343	1, 584, 017	1, 758, 476	2, 538, 951	+780, 475
Portage	75, 495	[c] 140, 874	[c] 98, 061	[c] 70, 512	[c] 118, 454	+ [c]28, 899
Stark	387, 074	449, 852	291, 890	420, 125	443, 562	+23, 437
Summit	31, 076	([c])	([c])	19, 043	([c])	([c])
Tuscarawas	1, 817, 096	2, 634, 927	1, 360, 779	1, 412, 203	1, 350, 324	−61, 879
Vinton	187, 509	322, 462	109, 311	107, 877	97, 109	−10, 768
Wayne	41, 443	57, 510	([c])	([c])	([c])	([c])
Small mines	186, 788	602, 000	([d])	308, 544	91, 668	−216, 876
	35, 876, 682	45, 878, 191	31, 942, 776	26, 953, 791	40, 546, 443	+13, 592, 652
Total value	$79, 496, 301	$175, 081, 000	$84, 686, 500	$87, 056, 000	$98, 610, 000	+$11, 554, 000

[a] Gallia includes Morgan and Washington in 1921; Morgan, Scioto, and Washington in 1922.

[b] Morgan includes Scioto and Washington in 1919; Washington in 1920; and Scioto and Washington production, and Gallia decrease in 1923; no production in Gallia County in 1923.

[c] Portage includes Summit in 1920; Summit and Wayne in 1921; Wayne in 1922; and Summit and Wayne in 1923.

[d] No canvass of wagon mines for 1921.

OKLAHOMA

The production of coal in Oklahoma in 1923 showed a slight increase over that of 1922—82,527 tons, or 2.9 per cent, but the total value decreased $653,000, or 5.7 per cent. The average number of days worked was larger, but the number of employees fell off.

The tons mined per day in the years 1918 to 1922 and the months of 1923 are shown in Figure 49.

TABLE 113.—*Coal produced in Oklahoma, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1922												
Coal	75, 351	1, 949	2, 547		79, 847	$371, 000	$4. 63	200	96	51	347	95
Latimer	180, 462	666	9, 970		191, 098	903, 000	4. 73	469	316	138	923	71
Le Flore	197, 152	5, 474	8, 775		211, 401	851, 000	4. 03	453	215	117	785	92
Okmulgee	823, 078	1, 305	5, 171		829, 554	3, 340, 000	4. 03	1, 505	654	306	2, 465	106
Pittsburg	898, 970	10, 698	112, 511		1, 022, 179	4, 244, 000	4. 15	1, 552	878	342	2, 772	128
Tulsa	216, 313	3, 433	2, 496		222, 242	896, 000	4. 03	111	37	121	269	196
Other counties [b]	216, 634	4, 856	5, 254		226, 744	837, 000	3. 69	100	38	129	267	209
Total, excluding wagon mines	2, 607, 960	28, 381	146, 724		2, 783, 065	11, 442, 000	4. 11	4, 390	2, 234	1, 204	7, 828	114
Wagon mines served by rail	19, 446				19, 446	85, 000	4. 35					
Grand total	2, 627, 406	28, 381	146, 724		2, 802, 511	11, 527, 000	4. 11					
1923												
Coal	30, 400	1, 884	1, 180		33, 464	149, 000	4. 46	84	42	18	144	108
Haskell	121, 882	1, 692	7, 121		130, 695	503, 000	3. 85	81	41	86	208	176
Latimer	127, 463	851	8, 830		137, 144	567, 000	4. 14	365	167	93	625	72
Le Flore	187, 061	12, 014	8, 201	7, 631	214, 907	855, 000	3. 98	491	230	152	873	103
Okmulgee	803, 092	1, 972	12, 986		818, 050	2, 719, 000	3. 32	1, 336	496	230	2, 062	97
Pittsburg	1, 154, 920	10, 434	76, 589		1, 241, 943	5, 011, 000	4. 03	1, 616	909	285	2, 810	174
Tulsa	190, 074	5, 705	2, 115		197, 894	702, 000	3. 55	95	29	169	293	191
Other counties [c]	62, 807	3, 446			66, 253	223, 000	3. 36	32	16	67	115	146
Total, excluding wagon mines	2, 677, 699	37, 998	117, 022	7, 631	2, 840, 350	10, 729, 000	3. 77	4, 100	1, 930	1, 100	7, 130	133
Wagon mines served by rail	44, 688				44, 688	145, 000	3. 25					
Grand total	2, 722, 387	37, 998	117, 022	7, 631	2, 885, 038	10, 874, 000	3. 77					

[a] Includes also loaders and shot firers.
[b] Craig, Haskell, Muskogee, Rogers, and Wagoner.
[c] Craig, Muskogee, Rogers, and Wagoner.

TABLE 114.—*Coal produced in Oklahoma, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Atoka and Haskell	129, 445	96, 070	83, 910	(a)	[a] 130, 695	(a)
Coal	427, 306	461, 394	187, 451	79, 847	33, 464	−46, 383
Craig	12, 707	12, 700	(b)	(b)	(b)	(b)
Latimer	697, 177	800, 442	344, 659	191, 098	137, 144	−53, 954
Le Flore	274, 597	411, 812	296, 814	211, 401	214, 907	+3, 506
Muskogee, Rogers, and Wagoner	48, 082	35, 323	[b] 27, 503	[b] 226, 744	[b] 66, 253	−[b] 29, 796
Okmulgee	965, 497	1, 477, 677	974, 457	829, 554	818, 050	−11, 504
Pittsburg	1, 170, 061	1, 404, 170	1, 283, 551	1, 022, 179	1, 241, 943	+219, 764
Tulsa	72, 467	130, 700	164, 278	222, 242	197, 894	−24, 348
Small mines	4, 774	19, 000	(c)	19, 446	44, 688	+25, 242
	3, 802, 113	4, 849, 288	3, 362, 623	2, 802, 511	2, 885, 038	+82, 527
Total value	$14, 544, 901	$23, 294, 000	$15, 546, 000	$11, 527, 000	$10, 874, 000	−$653, 000

[a] No production in Atoka in 1922 and 1923; Haskell included with Muskogee, etc., in 1922.
[b] Muskogee, etc., includes Craig in 1921; Craig and Haskell in 1922; and Craig in 1923.
[c] No canvass of wagon mines for 1921.

OREGON

The production of coal in Oregon, which had been decreasing, on the whole before 1918, showed an upward trend in both 1919 and 1920. These gains, however, have not been held, and beginning with 1921 the coal mined in this State has been included with that of California. The Coos Bay field is the only notable producing district in the State. Fuel oil, wood, and coal from other States dominate the local markets of Oregon, which has an exceedingly low per capita consumption.

TABLE 115.—*Coal produced in Oregon, 1918–1920*

Year	Net tons				Value		Number of employees	Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton		
1918	4, 112	3, 946	5, 270	13, 328	$37, 454	$2. 81	40	292
1919	10, 917	3, 103	4, 719	18, 739	63, 794	3. 40	67	259
1920	12, 980	1, 609	6, 128	20, 717	93, 000	4. 47	85	307

PENNSYLVANIA

ANTHRACITE

INTERPRETATION OF THE STATISTICS OF PRODUCTION

Unit of measurement.—Tables 116–136 present the statistics of the Pennsylvania anthracite industry in 1923. The figures are given in gross tons, the unit of measurement universally employed in the anthracite region. In general the form of the tables requires no comment, but there are certain new features in the statistical returns for 1923 to which attention should be called.

Fresh-mined, culm-bank, and river coal.—Anthracite is now produced from three sources—from mines, from old culm banks, and from the rivers that drain the anthracite region. The mines are of course the primary source. As it leaves the mines, the coal consists of fragments of all sizes from big lumps to fine dust and is further mingled with rock and refuse from the workings underground. To prepare it for the market, the coal is passed through a breaker, in which the refuse and impurities are removed, the largest lumps are crushed, and the cleaned product is sorted into the standard sizes demanded by the trade.

The breakers have always produced coal of a size too small to be marketed, though with increasing skill in the art of fuel utilization the limit of marketability has moved downward to smaller and smaller sizes. In the early days of the industry some of the chestnut and all the coal below chestnut size was unmarketable and was dumped in great piles or culm banks near the breakers, often without much thought of its future value. Later, when the market became more tolerant of the smaller coal, washeries were built to rework the coal in the culm banks and to recover the pea and as much of the steam sizes as could be disposed of. To-day all coal of the standard steam sizes—buckwheat, rice, and barley—and some material still smaller is sold or used for colliery fuel, and the old culm banks are being eaten away. Yet the counterpart of the old bank is seen in the accumulation of fine sediment from the wash water of the breakers, which careful operators recover in settling pools before allowing the water to escape to the streams. That a market for this material will develop seems reasonably sure.

Even present practice does not extract all the fine particles of coal from the waste water of the breakers and washeries. The blackened creeks and rivers of the region are still transporting millions of tons of carbon, and in the earlier days the quantities thus carried downstream were still greater. The deposition of this load of coal here and there on the river bottoms has created a third source of anthracite, from which, by dredging, some hundreds of thousands of tons of steam sizes are now recovered annually.

Difficulty of separating the statistics.—As all three sources—fresh-mined coal, culm-bank coal, and river coal—contribute to the country's supply of anthracite, it is important to cover them all in order to ascertain the total production. On the other hand, as the methods and cost of production differ greatly, it is important that the three sources be accurately distinguished in the statistics. No difficulty is experienced in separating the figures of production by dredges, because the operation is entirely distinct and is generally conducted by separate companies not connected with the mining corporations. Between the fresh-mined and the culm-bank coal, however, it is difficult to draw a sharp line that can be maintained throughout the statistics of the industry.

Breaker product includes some culm-bank coal.—At first thought it would appear that the output of the breakers might be taken as equivalent to the fresh-mined production and that of the washeries as equivalent to the culm-bank production. But to this statement, though in general true, there are many exceptions. Coal from a washery may be passed through a breaker for further sizing and cleaning. Again coal from a culm bank may go directly to a breaker for preparation without passing through a washery at all. The labor employed at the washery may at other times be engaged on a breaker of the same company, and the company may be unable to state accurately how the force is divided between its fresh-mined and its culm-bank operations. Yet it is desirable that the particulars of labor employed be exactly comparable with those of culm-bank and fresh-mined coal produced, because one man can produce much more culm-bank coal daily than fresh-mined coal. The difficulty is increased by the varying accounting practices of the companies.

Reconciliation of fresh-mined, culm-bank, and breaker product.—Faced with this problem, the Geological Survey has in recent years taken the individual breaker or washery as the producing unit to be canvassed in its statistical inquiries. The mining company has been asked to report not its total output of fresh-mined and washery coal, but rather the output of each breaker and each washery, with the related figures of men employed and time worked. From these individual breaker reports an effort was made, by further questioning of the producers, to eliminate the culm-bank coal, and a considerable tonnage was thus eliminated. The resulting statistics were published under the captions "fresh-mined coal" and "washery coal." Not satisfied with the accuracy of this separation, the Survey noted in its report for 1922, "It is probable that the statistics * * * slightly overstate the quantity of fresh-mined coal. They represent rather the total product of the breakers minus some but not all of the culm-bank coal. * * * In the forthcoming report for 1923 a more accurate measurement of the quantity derived from culm banks will be attempted."

For 1923, therefore, a supplemental inquiry was sent to the producers, in addition to the usual schedules for the operation of each breaker and washery, in which each company was asked for a recapitulation of its culm-bank and fresh-mined production from all operations combined. This inquiry showed that of the 78,468,375 tons handled by the breakers, 2,332,837 tons was bank coal. The fresh-mined coal proper was 76,135,538 tons. The quantity handled by washeries was 4,016,126 tons, but including the 2,332,837 tons of bank coal handled in breakers, the total produced from culm banks was 6,348,963 tons.

TABLE 116.—*Comparison of anthracite production in 1923 classified as fresh-mined, culm-bank, and river coal, and as breaker, washery, and dredge product, in gross tons*

	Classified by source of coal	Classified by type of preparation plant	Difference
Fresh-mined coal	76, 135, 538		+2, 332, 837
Breaker product		78, 468, 375	
Culm-bank coal	6, 348, 963		−2, 332, 837
Washery product		4, 016, 126	
River coal	853, 900		
Dredge product		853, 900	
	83, 338, 401	83, 338, 401	

Change in table captions.—The check makes it clear that the amount of culm-bank coal included in the figures published by the Geological Survey in recent years is sufficiently great so that the statistics should properly be presented as "breaker product" and "washery product" rather than as "freshly mined coal" and "culm-bank coal," or "washery coal," the captions previously used. This change is introduced in the tables of the present report.

PRODUCTION BY TRADE REGIONS, FIELDS, AND COUNTIES

The total quantity of anthracite produced in 1923 was 83,338,401 gross tons, with a value at the mines of $506,786,768 (Table 117). The quantity produced was the largest since 1918, and the value was the largest in the history of the industry.

In Tables 118 to 122 the statistics of production are presented by trade regions, fields, and counties. The classification by trade regions—Lehigh, Schuylkill, and Wyoming—is the one most commonly used by the trade. It is paralleled by the organization of the United Mine Workers, in which District No. 1 corresponds to the Wyoming trade region, District No. 7 to the Lehigh region, and District No. 9 to the Schuylkill region. In studies of costs of production and reserves, however, the classification by fields is the more useful, because it corresponds more closely to the geologic conditions which largely govern mining costs. The northern field is identical with the Wyoming region. That part of the southern field lying east of Tamaqua, known as the Panther Creek valley, together with the eastern middle field, make up the Lehigh region. That part of the southern field west of Tamaqua and the western middle field are together equivalent to the Schuylkill region. The Bernice Basin, in Sullivan County, is sometimes grouped with the Wyoming region, but in the tables of the Geological Survey it is generally shown separately.

The division by counties, shown in Table 122, is chiefly of interest in matters of local taxation.

TABLE 117.—*Total quantity and total value of anthracite produced, 1890–1923*

Year	Gross tons	Value	Year	Gross tons	Value
1890	41, 489, 858	[a] $66, 383, 772	1915	79, 459, 876	$184, 653, 498
1895	51, 785, 122	[a] 82, 019, 272	1916	78, 195, 083	202, 009, 561
1900	51, 221, 253	[a] 85, 757, 851	1917	88, 939, 117	283, 650, 723
1905	69, 339, 152	[a] 141, 879, 000	1918	88, 237, 575	336, 480, 347
1910	75, 433, 246	160, 275, 302	1919	78, 653, 751	364, 926, 950
1911	80, 771, 488	175, 189, 392	1920	79, 998, 437	434, 252, 198
1912	75, 322, 855	177, 622, 626	1921	80, 779, 867	452, 304, 903
1913	81, 718, 680	195, 181, 127	1922	48, 824, 127	273, 700, 125
1914	81, 090, 631	188, 181, 399	1923	83, 338, 401	506, 786, 768

[a] Excludes value of coal used at collieries.

TABLE 118.—*Anthracite produced, 1921–1923, by regions*

Region	Shipped		Sold locally		Colliery fuel		Total	
	Gross tons	Value [a]	Gross tons	Value	Gross tons	Value	Gross tons	Value [a]
1921								
Lehigh:								
Breaker product [b]	9, 092, 702	$56, 344, 295	537, 329	$1, 905, 323	1, 117, 214	$1, 774, 374	10, 747, 245	$60, 023, 992
Washery product	242, 944	1, 016, 075	14, 272	25, 608	1, 398	5, 065	258, 614	1, 046, 748
Dredge product	21, 599	27, 336			150	300	21, 749	27, 636
	9, 357, 245	57, 387, 706	551, 601	1, 930, 931	1, 118, 762	1, 779, 739	11, 027, 608	61, 098, 376
Schuylkill:								
Breaker product [b]	19, 382, 865	119, 259, 110	435, 606	2, 659, 909	3, 311, 935	2, 100, 261	23, 130, 406	124, 019, 280
Washery product	449, 390	1, 515, 108			88, 843	122, 682	538, 233	1, 637, 790
Dredge product	225, 913	220, 010	286, 725	363, 692	4, 550	4, 631	517, 188	588, 333
	20, 058, 168	120, 994, 228	722, 331	3, 023, 601	3, 405, 328	2, 227, 574	24, 185, 827	126, 245, 403
Wyoming:								
Breaker product [b]	39, 268, 163	248, 866, 892	1, 227, 457	6, 920, 174	3, 834, 466	4, 859, 113	44, 330, 086	260, 646, 179
Washery product	616, 102	2, 232, 474	241	506	303, 442	394, 783	919, 785	2, 627, 763
Dredge product	17, 199	33, 115	308	1, 520	100	50	17, 607	34, 685
	39, 901, 464	251, 132, 481	1, 228, 006	6, 922, 200	4, 138, 008	5, 253, 946	45, 267, 478	263, 308, 627
Sullivan County:								
Breaker product [b]	237, 686	1, 475, 463	9, 268	57, 474	52, 000	119, 560	298, 954	1, 652, 497
Total breaker product [b]	67, 981, 416	425, 945, 760	2, 209, 660	11, 542, 880	8, 315, 615	8, 853, 308	78, 506, 691	446, 341, 948
Total washery product	1, 308, 436	4, 763, 657	14, 513	26, 114	393, 683	522, 530	1, 716, 632	5, 312, 301
Total dredge product	264, 711	280, 461	287, 033	365, 212	4, 800	4, 981	556, 544	650, 654
Grand total	69, 554, 563	430, 989, 878	2, 511, 206	11, 934, 206	8, 714, 098	9, 380, 819	80, 779, 867	452, 304, 903
1922								
Lehigh:								
Breaker product [b]	5, 333, 272	33, 240, 557	348, 880	1, 405, 758	686, 948	1, 597, 440	6, 369, 100	36, 243, 755
Washery product	242, 433	946, 321	6, 457	5, 249	7, 019	25, 602	255, 909	977, 172
Dredge product	91, 128	106, 317					91, 128	106, 317
	5, 666, 833	34, 293, 195	355, 337	1, 411, 007	693, 967	1, 623, 042	6, 716, 137	37, 327, 244
Schuylkill:								
Breaker product [b]	11, 030, 848	69, 495, 332	407, 903	2, 561, 654	2, 294, 653	1, 695, 650	13, 733, 404	73, 752, 636
Washery product	1, 546, 695	5, 173, 923	2, 823	21, 847	106, 061	176, 546	1, 655, 579	5, 372, 316
Dredge product	429, 490	505, 838	232, 780	271, 876	5, 739	7, 749	668, 009	785, 463
	13, 007, 033	75, 175, 093	643. 506	2, 855, 377	2, 406, 453	1, 879, 945	16, 056, 992	79, 910, 415

[a] Value given for shipments is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated selling companies.
[b] Formerly presented under the caption "Freshly-mined coal." Includes a considerable tonnage of culm-bank coal handled in breakers.

TABLE 118.—*Anthracite produced, 1921–1923, by regions*—Continued

Region	Shipped		Sold locally		Colliery fuel		Total	
	Gross tons	Value	Gross tons	Value	Gross tons	Value	Gross tons	Value
1922—Continued								
Wyoming:								
Breaker product [b]	21,331,904	$141,301,938	1,099,040	$6,430,312	2,292,100	$3,868,636	24,723,044	$151,600,886
Washery product	811,353	3,191,371	17,069	29,311	203,376	341,605	1,031,798	3,562,287
Dredge product	46,236	94,192	1,866	3,737			48,102	97,929
	22,189,493	144,587,501	1,117,975	6,463,360	2,495,476	4,210,241	25,802,944	155,261,102
Sullivan County:								
Breaker product [b]	210,479	1,098,749	6,575	40,615	31,000	62,000	248,054	1,201,364
Total breaker product [b]	37,906,503	245,136,576	1,862,398	10,438,339	5,304,701	7,223,726	45,073,602	262,798,641
Total washery product	2,600,481	9,311,615	26,349	56,407	316,456	543,753	2,943,286	9,911,775
Total dredge product	566,854	706,347	234,646	275,613	5,739	7,749	807,239	989,709
Grand total	41,073,838	255,154,538	2,123,393	10,770,359	5,626,896	7,775,228	48,824,127	273,700,125
1923								
Lehigh:								
Breaker product	9,538,147	62,782,100	558,796	2,135,158	1,008,884	1,752,849	11,105,827	66,670,107
Washery product	521,744	1,675,656	3,383	3,403	19,363	68,881	544,490	1,747,940
Dredge product	94,725	124,538					94,725	124,538
	10,154,616	64,582,294	562,179	2,138,561	1,028,247	1,821,730	11,745,042	68,542,585
Schuylkill:								
Breaker product	20,377,383	133,635,367	554,910	3,570,662	2,626,295	1,887,047	23,558,588	139,093,076
Washery product	1,552,511	6,185,369	186	1,110	59,537	47,550	1,612,234	6,234,029
Dredge product	284,682	306,184	462,231	369,520	6,370	5,107	753,283	680,811
	22,214,576	140,126,920	1,017,327	3,941,292	2,692,202	1,939,704	25,924,105	146,007,916
Wyoming:								
Breaker product	39,092,074	270,555,028	1,308,115	7,761,854	3,110,108	4,353,633	43,510,297	282,670,515
Washery product	1,680,032	7,215,898	4,852	14,611	174,518	352,536	1,859,402	7,583,045
Dredge product	5,592	5,476			300	240	5,892	5,716
	40,777,698	277,776,402	1,312,967	7,776,465	3,284,926	4,706,409	45,375,591	290,259,276
Sullivan county:								
Breaker product	280,822	1,912,541	7,841	51,450	5,000	13,000	293,663	1,976,991
Total breaker product	69,288,426	468,885,036	2,429,662	13,519,124	6,750,287	8,006,529	[c] 78,468,375	490,410,689
Total washery product	3,754,287	15,076,923	8,421	19,124	253,418	468,967	4,016,126	15,565,014
Total dredge product	384,999	436,198	462,231	369,520	6,670	5,347	853,900	811,065
Grand total	73,427,712	484,398,157	2,900,314	13,907,768	7,010,375	8,480,843	83,338,401	506,786,768

[b] Formerly presented under the caption "Freshly-mined coal." Includes a considerable tonnage of culm-bank coal handled in breakers.
[c] Includes about 2,300,000 tons of culm-bank coal put through the breakers.

TABLE 119.—*Anthracite produced, 1916–1923*

	Shipped		Sold locally		Colliery fuel		Total	
	Gross tons	Value [a]	Gross tons	Value	Gross tons	Value	Gross tons	Value [a]
1916								
Breaker product [b]	64, 367, 754	$189, 472, 889	1, 833, 799	$4, 483, 462	7, 833, 181	$3, 631, 497	74, 034, 734	$197, 587, 848
Washery product	3. 104, 214	3, 840, 147	85, 444	73, 955	827, 381	396, 780	4, 017, 039	4, 310, 882
Dredge product	29, 395	23, 851	59, 406	61, 939	54, 509	25, 041	143, 310	110, 831
	67, 501, 363	193, 336, 887	1, 978, 649	4, 619, 356	8, 715, 071	4, 053, 318	78, 195, 083	202, 009, 561
1917								
Breaker product [b]	72, 077, 334	258, 169, 329	2, 060, 404	5, 979, 059	8, 421, 211	7, 650, 520	82, 558, 949	271, 798, 908
Washery product	5, 365, 517	10, 953, 668	13, 193	20, 720	849, 072	670, 673	6, 227, 782	11, 645, 061
Dredge product	47, 192	70, 804	53, 512	71, 128	51, 682	64, 822	152, 386	206, 754
	77, 490, 043	269, 193, 801	2, 127, 109	6, 070, 907	9, 321, 965	8, 386, 015	88, 939, 117	283, 650, 723
1918								
Breaker product [b]	70, 090, 234	299, 094, 304	2, 238, 447	7, 554, 157	8, 173, 702	9, 842, 547	80, 502, 383	316, 491, 008
Washery product	6, 506, 487	18, 220, 906	22, 759	36, 747	953, 330	1, 365, 121	7, 482, 576	19, 622, 774
Dredge product	124, 436	206, 971	126, 686	155, 352	1, 494	4, 242	252, 616	366, 565
	76, 721, 157	317, 522, 181	2, 387, 892	7, 746, 256	9, 128, 526	11, 211, 910	88, 237, 575	336, 480, 347
1919								
Breaker product [b]	64, 631, 703	335, 134, 951	1, 812, 622	7, 950, 638	7, 717, 629	10, 018, 860	74, 161, 954	353, 104, 449
Washery product	3, 016, 903	9, 625, 998	7, 238	22, 312	848, 823	1, 305, 445	3, 872, 964	10, 953, 755
Dredge product	323, 689	440, 733	288, 016	415, 596	7. 128	12, 417	618, 833	868, 746
	67, 972, 295	345, 201, 682	2, 107, 876	8, 388, 546	8, 573, 580	11, 336, 722	78, 653, 751	364, 926, 950
1920								
Breaker product [b]	63, 598, 683	391, 612, 035	2, 276, 387	11, 045, 824	7, 792, 983	10, 743, 172	73, 668, 053	413, 401, 031
Washery product	4, 615, 514	17, 684, 475	51, 476	123, 969	1, 002, 275	2, 180, 427	5, 669, 265	19, 988, 871
Dredge product	396, 566	544, 105	258, 300	309, 903	6, 253	8, 288	661, 119	862, 296
	68, 610, 763	409, 840, 615	2, 586, 163	11, 479, 696	8, 801, 511	12, 931, 887	79, 998, 437	434. 252, 198

[a] Value given for shipments is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated selling companies.
[b] Formerly presented under the caption "Freshly mined-coal." Includes a considerable tonnage of culm-bank coal handled in breakers.

TABLE 119.—*Anthracite produced, 1916–1923*—Continued

	Shipped		Sold locally		Colliery fuel		Total	
	Gross tons	Value	Gross tons	Value	Gross tons	Value	Gross tons	Value
1921								
Breaker product [b]	67, 981, 416	$425, 945, 760	2, 209, 660	$11, 542, 880	8, 315, 615	$8, 853, 308	78, 506, 691	$446, 341, 948
Washery product	1, 308, 436	4, 763, 657	14, 513	26, 114	393, 683	522, 530	1, 716, 632	5, 312, 301
Dredge product	264, 711	280, 461	287, 033	365, 212	4, 800	4, 981	556, 544	650, 654
	69, 554, 563	430, 989, 878	2, 511, 206	11, 934, 206	8, 714, 098	9, 380, 819	80, 779, 867	452, 304, 903
1922								
Breaker product [b]	37, 906, 503	245, 136, 576	1, 862, 398	10, 438, 339	5, 304, 701	7, 223, 726	45, 073, 602	262, 798, 641
Washery product	2, 600, 481	9, 311, 615	26, 349	56, 407	316, 456	543, 753	2, 943, 286	9, 911, 775
Dredge product	566, 854	706, 347	234, 646	275, 613	5, 739	7, 749	807, 239	989, 709
	41, 073, 838	255, 154, 538	2, 123, 393	10, 770, 359	5, 626, 896	7, 775, 228	48, 824, 127	273, 700, 125
1923								
Breaker product [c]	69, 288, 426	468, 885, 036	2, 429, 662	13, 519, 124	6, 750, 287	8, 006, 529	[c]78, 468, 375	490, 410, 689
Washery product	3, 754, 287	15, 076, 923	8, 421	19, 124	253, 418	468, 967	4, 016, 126	15, 565, 014
Dredge product	384, 999	436, 198	462, 231	369, 520	6, 670	5, 347	853, 900	811, 065
	73, 427, 712	484, 398, 157	2, 900, 314	13, 907, 768	7, 010, 375	8, 480, 843	83, 338, 401	506, 786, 768

[b] Formerly presented under the caption "Freshly-mined coal." Includes a considerable tonnage of culm-bank coal handled in breakers.

[c] Includes about 2,300,000 tons of culm-bank coal put through the breakers.

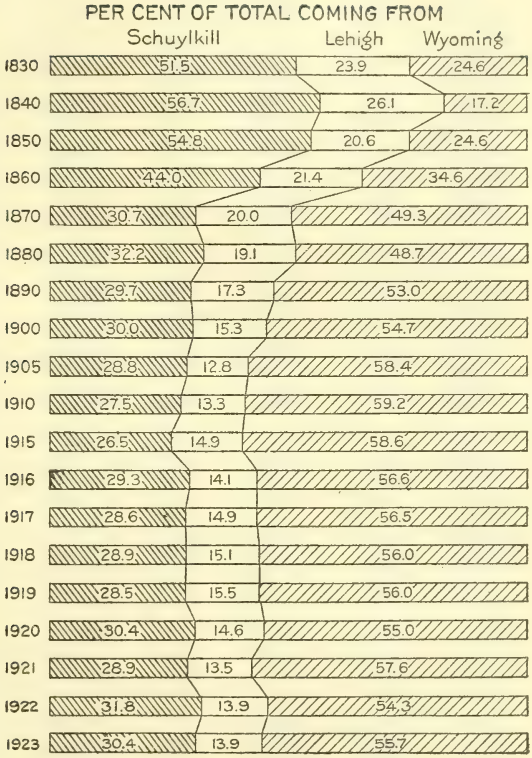

FIGURE 53.—Shipments of anthracite by regions, 1830–1923

TABLE 120.—*Anthracite shipped from the Schuylkill, Lehigh, and Wyoming regions, 1807 and 1820–1923*

Year	Schuylkill region		Lehigh region		Wyoming region		Total (gross tons)
	Gross tons	Percentage	Gross tons	Percentage	Gross tons	Percentage	
1807					55		55
1820			365				365
1821			1,073				1,073
1822	1,480	39.8	2,240	60.2			3,720
1823	1,128	16.2	5,823	83.8			6,951
1824	1,567	14.1	9,541	85.9			11,108
1825	6,500	18.6	28,393	81.4			34,893
1826	16,767	34.9	31,280	65.1			48,047
1827	31,360	49.4	32,074	50.6			63,434
1828	47,284	61.0	30,232	39.0			77,516
1829	79,973	71.4	25,110	22.4	7,000	6.2	112,083
1830	89,984	51.5	41,750	23.9	43,000	24.6	174,734
1831	81,854	46.3	40,966	23.2	54,000	30.5	176,820
1832	209,271	57.6	70,000	19.3	84,000	23.1	363,271
1833	252,971	51.9	123,001	25.2	111,777	22.9	487,749
1834	226,692	60.2	106,244	28.2	43,700	11.6	376,636
1835	339,508	60.5	131,250	23.4	90,000	16.1	560,758
1836	432,045	63.1	148,211	21.7	103,861	15.2	684,117
1837	530,152	61.0	223,902	25.7	115,387	13.3	869,441
1838	446,875	60.5	213,615	28.9	78,207	10.6	738,697
1839	475,077	58.1	221,025	27.0	122,300	14.9	818,402
1840	490,596	56.7	225,313	26.1	148,470	17.2	864,379
1841	624,466	65.1	143,037	14.9	192,270	20.0	959,773
1842	583,273	52.6	272,540	24.6	252,599	22.8	1,108,412
1843	710,200	56.2	267,793	21.2	285,605	22.6	1,263,598
1844	887,937	54.5	377,002	23.1	365,911	22.4	1,630,850
1845	1,131,724	56.2	429,453	21.3	451,836	22.5	2,013,013
1846	1,308,500	55.8	517,116	22.1	518,389	22.1	2,344,005
1847	1,665,735	57.8	633,507	22.0	583,067	20.2	2,882,309
1848	1,733,721	56.1	670,321	21.7	685,196	22.2	3,089,238
1849	1,728,500	53.3	781,556	24.1	732,910	22.6	3,242,966
1850	1,840,620	54.8	690,456	20.6	827,823	24.6	3,358,899
1851	2,328,525	52.3	964,224	21.7	1,156,167	26.0	4,448,916
1852	2,636,835	52.8	1,072,136	21.5	1,284,500	25.7	4,993,471
1853	2,665,110	51.3	1,054,309	20.3	1,475,732	28.4	5,195,151
1854	3,191,670	53.2	1,207,186	20.1	1,603,478	26.7	6,002,334
1855	3,552,943	53.8	1,284,113	19.4	1,771,511	26.8	6,608,567
1856	3,603,029	52.0	1,351,970	19.5	1,972,581	28.5	6,927,580
1857	3,373,797	50.8	1,318,541	19.8	1,952,603	29.4	6,644,941
1858	3,273,245	47.9	1,380,030	20.2	2,186,094	31.9	6,839,369
1859	3,448,708	44.1	1,628,311	20.9	2,731,236	35.0	7,808,255
1860	3,749,632	44.0	1,821,674	21.4	2,941,817	34.6	8,513,123
1861	3,160,747	39.7	1,738,377	21.9	3,055,140	38.4	7,954,264
1862	3,372,583	42.8	1,351,054	17.2	3,145,770	40.0	7,869,407
1863	3,911,683	40.9	1,894,713	19.8	3,759,610	39.3	9,566,006
1864	4,161,970	40.9	2,054,669	20.2	3,960,836	38.9	10,177,475
1865	4,356,959	45.2	2,040,913	21.1	3,254,519	33.7	9,652,391
1866	5,787,902	45.6	2,179,364	17.1	4,736,616	37.3	12,703,882
1867	5,161,671	39.7	2,502,054	19.3	5,325,000	41.0	12,988,725
1868	5,330,737	38.6	2,502,582	18.1	5,968,146	43.3	13,801,465
1869	5,775,138	41.7	1,949,673	14.0	6,141,369	44.3	13,866,180
1870	4,968,157	30.7	3,239,374	20.0	7,974,660	49.3	16,182,191
1871	6,552,772	41.8	2,235,707	14.2	6,911,242	44.0	15,699,721
1872	6,694,890	34.1	3,873,339	19.7	9,101,549	46.2	19,669,778
1873	7,212,601	34.0	3,705,596	17.4	10,309,755	48.6	21,227,952
1874	6,866,877	34.1	3,773,836	18.7	9,504,408	47.2	20,145,121
1875	6,281,712	31.9	2,834,605	14.4	10,596,155	53.7	19,712,472

TABLE 120.—*Anthracite shipped from the Schuylkill, Lehigh, and Wyoming regions, 1807 and 1820–1923*—Continued

Year	Schuylkill region		Lehigh region		Wyoming region		Total (gross tons)
	Gross tons	Percentage	Gross tons	Percentage	Gross tons	Percentage	
1876	6, 221, 934	33. 6	3, 854, 919	20. 9	8, 424, 158	45. 5	18, 501, 011
1877	8, 195, 042	39. 3	4, 332, 760	20. 8	8, 300, 377	39. 9	20, 828, 179
1878	6, 282, 226	35. 7	3, 237, 449	18. 4	8, 085, 587	45. 9	17, 605, 262
1879	8, 960, 829	34. 3	4, 595, 567	17. 6	12, 586, 293	48. 1	26, 142, 689
1880	7, 554, 742	32. 3	4, 463, 221	19. 0	11, 419, 279	48. 7	23, 437, 242
1881	9, 253, 958	32. 4	5, 294, 676	18. 6	13, 951, 383	49. 0	28, 500, 017
1882	9, 459, 288	32. 5	5, 689, 437	19. 5	13, 971, 371	48. 0	29, 120, 096
1883	10, 074, 726	31. 7	6, 113, 809	19. 2	15, 604, 492	49. 1	31, 793, 027
1884	9, 478, 314	30. 9	5, 562, 226	18. 1	15, 677, 753	51. 0	30, 718, 293
1885	9, 488, 426	30. 0	5, 898, 634	18. 7	16, 236, 470	51. 3	31, 623, 530
1886	9, 381, 407	29. 2	5, 723, 129	17. 8	17, 031, 826	53. 0	32, 136, 362
1887	10, 609, 028	30. 6	4, 347, 061	12. 6	19, 684, 929	56. 8	34, 641, 018
1888	10, 654, 116	27. 9	5, 639, 236	14. 8	21, 852, 366	57. 3	38, 145, 718
1889	10, 486, 185	29. 3	6, 294, 073	17. 6	19, 036, 835	53. 1	35, 817, 093
1890	10, 867, 822	29. 7	6, 329, 658	17. 3	19, 417, 979	53. 0	36, 615, 459
1891	12, 741, 258	31. 5	6, 381, 838	15. 8	21, 325, 240	52. 7	40, 448, 336
1892	12, 626, 784	30. 1	6, 451, 076	15. 4	22, 815, 480	54. 5	41, 893, 340
1893	12, 357, 444	28. 7	6, 892, 352	16. 0	23, 839, 741	55. 3	43, 089, 537
1894	12, 035, 005	29. 1	6, 705, 434	16. 2	22, 650, 761	54. 7	41, 391, 200
1895	14, 269, 932	30. 7	7, 298, 124	15. 7	24, 943, 421	53. 6	46, 511, 477
1896	13, 097, 571	30. 4	6, 490, 441	15. 0	23, 589, 473	54. 6	43, 177, 485
1897	12, 181, 061	29. 3	6, 249, 540	15. 0	23, 207, 263	55. 7	41, 637, 864
1898	12, 078, 875	28. 8	6, 253, 109	14. 9	23, 567, 767	56. 3	41, 899, 751
1899	14, 199, 009	29. 8	6, 887, 909	14. 4	26, 578, 286	55. 8	47, 665, 204
1900	13, 502, 732	30. 0	6, 918, 627	15. 3	24, 686, 125	54. 7	45, 107, 484
1901	16, 019, 591	29. 9	7, 211, 974	13. 5	30, 337, 036	56. 6	53, 568, 601
1902	8, 471, 391	27. 2	3, 470, 736	11. 1	19, 258, 763	61. 7	31, 200, 890
1903	16, 474, 790	27. 7	7, 164, 783	12. 1	35, 723, 258	60. 2	59, 362, 831
1904	16, 379, 293	28. 5	7, 107, 220	12. 4	34, 006, 009	59. 1	57, 492, 522
1905	17, 703, 099	28. 8	7, 849, 205	12. 8	35, 857, 897	58. 4	61, 410, 201
1906	16, 011, 285	28. 8	7, 046, 617	12. 6	32, 640, 693	58. 6	55, 698, 595
1907	20, 141, 288	30. 0	8, 329, 653	12. 4	38, 638, 452	57. 6	67, 109, 393
1908	18, 006, 464	27. 9	7, 786, 255	12. 0	38, 872, 295	60. 1	64, 665, 014
1909	16, 864, 147	27. 2	7, 532, 271	12. 2	37, 573, 467	60. 6	61, 969, 885
1910	17, 845, 020	27. 5	8, 627, 539	13. 3	38, 433, 227	59. 2	64, 905, 786
1911	19, 118, 300	27. 4	9, 682, 147	13. 9	41, 033, 354	58. 7	69, 833, 801
1912	18, 213, 960	28. 2	8, 800, 125	13. 6	37, 653, 164	58. 2	64, 667, 249
1913	19, 417, 385	27. 4	10, 180, 021	14. 4	41, 160, 906	58. 2	70, 758, 312
1914 [a]	18, 416, 586	26. 3	10, 272, 308	14. 7	41, 258, 463	59. 0	69, 947, 357
1915 [a]	18, 043, 709	26. 5	10, 190, 421	14. 9	39, 945, 344	58. 6	68, 179, 474
1916 [a]	19, 677, 476	29. 3	9, 437, 545	14. 1	37, 945, 335	56. 6	67, 060, 356
1917 [a]	22, 028, 055	28. 6	11, 456, 963	14. 9	43, 577, 769	56. 5	77, 062, 787
1918 [a]	22, 009, 607	28. 9	11, 552, 042	15. 1	42, 746, 038	56. 0	76, 307, 687
1919 [a]	19, 248, 280	28. 5	10, 452, 093	15. 5	37, 899, 347	56. 0	67, 599, 720
1920 [a]	20, 733, 428	30. 4	9, 939, 241	14. 6	37, 517, 036	55. 0	68, 189, 705
1921 [a]	20, 058, 168	28. 9	9, 357, 245	13. 5	39, 901, 464	57. 6	69, 316, 877
1922 [a]	13, 007, 033	31. 8	5, 666, 833	13. 9	22, 189, 493	54. 3	40, 863, 359
1923 [a]	22, 214, 576	30. 4	10, 154, 616	13. 9	40, 777, 698	55. 7	73, 146, 890
	809, 556, 298	30. 7	400, 624, 697	15. 2	1, 422, 149, 020	54. 1	2, 632, 330, 015

[a] 1914–1923 inclusive of dredge shipments.

TABLE 121.—*Anthracite produced, by fields, 1913–1923, in gross tons*

[The figures of breaker product include a certain quantity of culm-bank coal, which in 1923 amounted to about 2,300,000 tons]

Year	Northern field [a]				Eastern middle field			Western middle field			
	Breakers	Washeries	Dredges	Total	Breakers	Washeries	Total	Breakers	Washeries	Dredges	Total
1913	45, 117, 000	1, 915, 000	42, 000	47, 074, 000	7, 479, 000	36, 000	7, 515, 000	15, 584, 000	133, 000	13, 000	15, 730, 000
1914	45, 462, 000	1, 782, 000	3, 000	47, 247, 000	7, 831, 000	35, 000	7, 866, 000	14, 562, 000	215, 000	12, 000	14, 789, 000
1915	43, 600, 000	2, 249, 000	----------	45, 849, 000	7, 664, 000	87, 000	7, 751, 000	14, 564, 000	327, 000	27, 000	14, 918, 000
1916	41, 296, 000	2, 374, 000	4, 000	43, 674, 000	7, 030, 000	77, 000	7, 107, 000	15, 666, 000	532, 000	28, 000	16, 226, 000
1917	46, 201, 000	3, 432, 000	3, 000	49, 636, 000	7, 576, 000	85, 000	7, 661, 000	17, 821, 000	1, 074, 000	44, 000	18, 939, 000
1918	45, 213, 000	3, 529, 000	3, 000	48, 745, 000	7, 631, 000	112, 000	7, 743, 000	17, 289, 000	1, 486, 000	102, 000	18, 877, 000
1919	41, 650, 000	1, 801, 000	18, 000	43, 469, 000	7, 284, 000	288, 000	7, 572, 000	14, 983, 000	871, 000	247, 000	16, 101, 000
1920	40, 398, 000	2, 939, 000	29, 000	43, 366, 000	7, 010, 000	115, 000	7, 125, 000	16, 123, 000	942, 000	240, 000	17, 305, 000
1921	44, 629, 000	920, 000	35, 000	45, 584, 000	6, 862, 000	78, 000	6, 940, 000	16, 674, 000	319, 000	199, 000	17, 192, 000
1922	24, 971, 000	1, 032, 000	48, 000	26, 051, 000	4, 121, 000	36, 000	4, 157, 000	9, 651, 000	995, 000	194, 000	10, 840, 000
1923	43, 804, 000	1, 859, 000	28, 000	45, 691, 000	7, 039, 000	122, 000	7, 161, 000	16, 548, 000	1, 019, 000	194, 000	17, 761, 000

Year	Southern field				Total			
	Breakers	Washeries	Dredges	Total	Breakers	Washeries	Dredges	Total
1913	10, 545, 000	776, 000	79, 000	11, 400, 000	78, 725, 000	2, 860, 000	134, 000	81, 719, 000
1914	10, 608, 000	493, 000	88, 000	11, 189, 000	78, 463, 000	2, 525, 000	103, 000	81, 091, 000
1915	10, 361, 000	484, 000	97, 000	10, 942, 000	76, 189, 000	3, 147, 000	124, 000	79, 460, 000
1916	10, 043, 000	1, 034, 000	111, 000	11, 188, 000	74, 035, 000	4, 017, 000	143, 000	78, 195, 000
1917	10, 961, 000	1, 637, 000	105, 000	12, 703, 000	82, 559, 000	6, 228, 000	152, 000	88, 939, 000
1918	10, 369, 000	2, 356, 000	148, 000	12, 873, 000	80, 502, 000	7, 483, 000	253, 000	88, 238, 000
1919	10, 245, 000	913, 000	354, 000	11, 512, 000	74, 162, 000	3, 873, 000	619, 000	78, 654, 000
1920	10, 137, 000	1, 673, 000	392, 000	12, 202, 000	73, 668, 000	5, 669, 000	661, 000	79, 998, 000
1921	10, 341, 000	400, 000	323, 000	11, 064, 000	78, 507, 000	1, 717, 000	556, 000	80, 780, 000
1922	6, 331, 000	880, 000	565, 000	7, 776, 000	45, 074, 000	2, 943, 000	807, 000	48, 824, 000
1923	11, 077, 000	1, 016, 000	632, 000	12, 725, 000	78, 468, 000	4, 016, 000	854, 000	83, 338, 000

[a] Includes Sullivan County, which in 1923 contributed 293,663 tons of breaker product.

TABLE 122.—*Anthracite produced, 1922–23, by counties*

County	Shipped		Sold locally		Colliery fuel		Total	
	Gross tons	Value [a]	Gross tons	Value	Gross tons	Value	Gross tons	Value [a]
1922								
Berks [b]	26,000	$55,000	33,000	$78,000			59,000	$133,000
Carbon	1,468,000	8,329,000	50,000	174,000	171,000	$417,000	1,689,000	8,920,000
Columbia	337,000	1,766,000	19,000	45,000	39,000	95,000	395,000	1,906,000
Cumberland [b] and Susquehanna	11,000	83,000	7,000	5,000			18,000	88,000
Dauphin	656,000	2,816,000	140,000	275,000	156,000	272,000	952,000	3,363,000
Lackawanna	8,780,000	56,703,000	384,000	2,427,000	910,000	1,553,000	10,074,000	60,683,000
Luzerne	15,786,000	102,887,000	1,036,000	5,169,000	1,888,000	3,283,000	18,710,000	111,339,000
Montour [b]	2,000	4,000	1,000	1,000			3,000	5,000
Northampton [b]	61,000	65,000					61,000	65,000
Northumberland	3,007,000	18,172,000	149,000	849,000	651,000	562,000	3,807,000	19,583,000
Schuylkill	10,416,000	61,270,000	292,000	1,680,000	1,770,000	1,511,000	12,478,000	64,461,000
Sullivan	210,000	1,099,000	7,000	40,000	31,000	62,000	248,000	1,201,000
Wayne	276,000	1,865,000	5,000	27,000	11,000	20,000	292,000	1,912,000
York [b]	38,000	41,000					38,000	41,000
	41,074,000	255,155,000	2,123,000	10,770,000	5,627,000	7,775,000	48,824,000	273,700,000
1923								
Berks [b]	23,000	49,000	19,000	30,000			42,000	79,000
Carbon	2,509,000	14,847,000	94,000	308,000	227,000	541,000	2,830,000	15,696,000
Columbia	940,000	5,146,000	25,000	99,000	114,000	141,000	1,079,000	5,386,000
Cumberland,[b] Lancaster,[b] and York [b]	76,000	71,000	37,000	29,000			113,000	100,000
Dauphin	807,000	5,223,000	386,000	458,000	110,000	192,000	1,303,000	5,873,000
Lackawanna	16,861,000	114,842,000	461,000	2,854,000	1,124,000	1,721,000	18,446,000	119,417,000
Lehigh [b] and Montour [b]	34,000	41,000	1,000	1,000			35,000	42,000
Luzerne	28,076,000	191,922,000	1,255,000	6,492,000	2,665,000	3,726,000	31,996,000	202,140,000
Northumberland	5,249,000	32,720,000	145,000	898,000	803,000	758,000	6,197,000	34,376,000
Schuylkill	17,802,000	112,558,000	451,000	2,563,000	1,908,000	1,295,000	20,161,000	116,416,000
Sullivan	281,000	1,913,000	8,000	52,000	5,000	13,000	294,000	1,978,000
Susquehanna and Wayne	770,000	5,066,000	18,000	124,000	54,000	94,000	842,000	5,284,000
	73,428,000	484,398,000	2,900,000	13,908,000	7,010,000	8,481,000	83,338,000	506,787,000

[a] Value given for shipments is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated selling companies.
[b] Counties producing dredge coal only.

MONTHLY SHIPMENTS

The monthly shipments of anthracite outside the region as reported by the Anthracite Bureau of Information are given in Table 123. They do not include dredge coal or the product of the Bernice Basin. Unfortunately, since November, 1923, the Bureau has been unable to obtain the figures of one important producer, and the current reports are no longer complete. In the interest of the public, as well as the industry, it is hoped that the publication of complete figures may be resumed.

Weekly production statistics for 1922 and 1923 are given on page 540.

TABLE 123.—*Anthracite shipped, 1917–1923, by months, in gross tons* [a]

Month	1917	1918	1919	1920	1921	1922	1923
January	5, 940, 725	5, 638, 383	5, 934, 241	5, 713, 319	5, 740, 538	4, 848, 053	6, 671, 822
February	5, 178, 432	5, 812, 082	3, 871, 932	4, 913, 664	5, 966, 101	5, 239, 014	5, 951, 713
March	6, 989, 075	7, 276, 777	3, 938, 908	6, 077, 821	5, 737, 771	6, 778, 667	7, 183, 518
April	5, 592, 299	6, 368, 373	5, 224, 715	4, 814, 211	5, 967, 465	([b])	6, 173, 774
May	6, 917, 525	6, 887, 256	5, 711, 915	6, 155, 878	5, 793, 895	([b])	6, 564, 285
June	7, 049, 037	6, 867, 669	5, 619, 591	6, 319, 957	6, 031, 937	([b])	6, 634, 787
July	6, 724, 252	7, 084, 775	6, 052, 334	6, 389, 100	5, 462, 760	([b])	6, 260, 053
August	7, 013, 996	7, 180, 923	6, 144, 144	6, 207, 653	5, 575, 115	([b])	6, 672, 855
September	6, 372, 756	6, 234, 395	5, 687, 401	3, 592, 954	5, 519, 412	3, 746, 433	2, 194, 940
October	7, 110, 950	6, 286, 366	6, 560, 150	6, 240, 901	5, 872, 783	6, 567, 928	6, 564, 526
November	6, 545, 313	5, 276, 659	5, 971, 671	5, 765, 347	5, 314, 014	6, 420, 102	5, 828, 754
December	5, 698, 945	5, 736, 260	6, 138, 460	6, 436, 320	4, 635, 922	6, 454, 876	[c] 6, 000, 000
	77, 133, 305	76, 649, 918	66, 855, 462	68, 627, 125	67, 617, 713	40, 055, 073	72, 701, 027

[a] Does not include shipments from Sullivan County or from dredges.
[b] Strike.
[c] Estimate. No report by the Anthracite Bureau of Information.

NUMBER OF OPERATORS

Sustained demand and favorable prices after the strike of 1922 called into active operation all available plants in 1923. The number of breakers active was 257, against 243 in 1922, and the number of washeries 82, against 69. The number of dredges in operation for which the Geological Survey obtained information was 60, against 62 in 1922. Definite reports were received from all dredge operators on its lists, but the Survey can not guarantee that its present lists are complete, because a systematic field canvass of the dredge industry has not been made since 1920.

TABLE 124.—*Number of anthracite breakers, washeries, and dredges active, 1918–1923*

	1918	1919	1920	1921	1922	1923		1918	1919	1920	1921	1922	1923
Lehigh:							Wyoming:						
Breakers	34	34	36	33	32	33	Breakers	139	142	135	130	131	144
Washeries	11	12	10	11	11	12	Washeries	40	42	33	27	34	44
Dredges	-----	3	3	1	4	3	Dredges	1	3	1	2	2	1
	45	49	49	45	47	48		180	187	169	159	167	189
							Sullivan County: Breakers	3	3	3	3	2	2
Schuylkill:													
Breakers	78	80	78	79	78	78	Total breakers	254	259	252	245	243	257
Washeries	25	24	19	17	24	26	Total washeries	76	78	62	55	69	82
Dredges	31	74	56	59	56	56	Total dredges	32	80	60	62	62	60
	134	178	153	155	158	160	Grand total	362	417	374	362	374	399

SHIPMENTS FROM BREAKERS, WASHERIES, AND DREDGES, 1890-1923

The shortage of anthracite and of bituminous coal created by the strike of 1922 led to favorable prices for the steam sizes of anthracite and caused an increase in the quantity of washery coal in 1923. As shown in Figure 54 and Table 125 the shipments from washeries have been exceeded but three times in recent years—namely, in 1917, 1918, and 1920. Attention has already been called to the facts that the figures of "washery product" are somewhat less than the quantity of coal recovered from culm banks and that some culm-bank coal is prepared in the breakers and here appears in the breaker shipments.

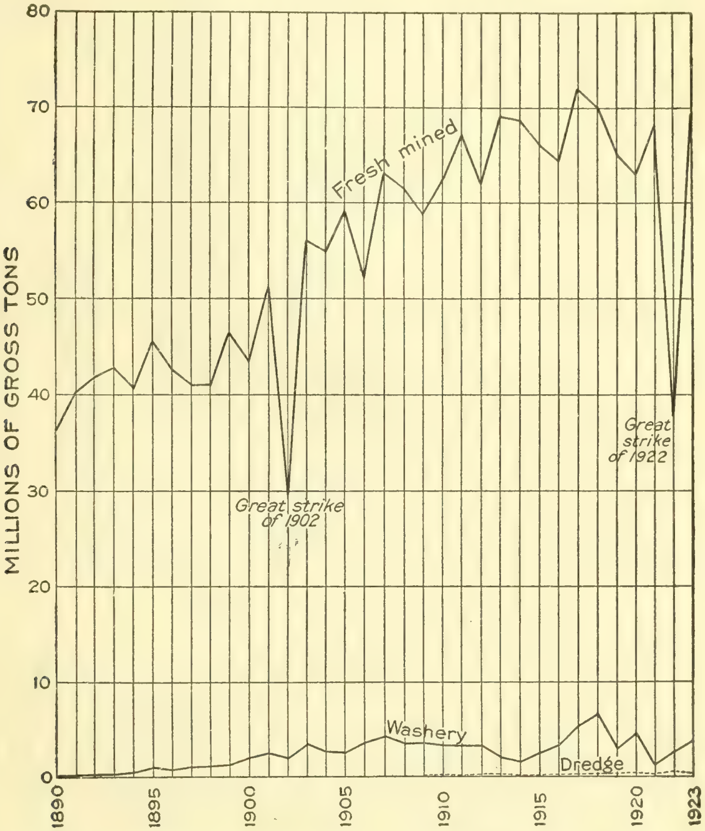

FIGURE 54.—Anthracite shipped from breakers, washeries, and dredges, 1890–1923. (Includes Sullivan County.)

TABLE 125.—*Anthracite shipped from breakers, washeries, and dredges, 1890–1923, in gross tons* [a]

Year	Breakers [b]	Washeries [b]	Dredges	Total
1890	36, 573, 000	42, 000		36, 615, 000
1891	40, 362, 000	86, 000		40, 448, 000
1892	41, 803, 000	90, 000		41, 893, 000
1893	42, 845, 000	245, 000		43, 090, 000
1894	40, 757, 000	634, 000		41, 391, 000
1895	45, 430, 000	1, 081, 000		46, 511, 000
1896	42, 282, 000	895, 000		43, 177, 000
1897	40, 802, 000	994, 000		41, 796, 000
1898	40, 944, 000	1, 099, 000		42, 043, 000
1899	46, 455, 000	1, 368, 000		47, 823, 000
1900	43, 218, 000	2, 059, 000		45, 277, 000
1901	51, 128, 000	2, 567, 000		53, 695, 000
1902	29, 527, 000	1, 959, 000		31, 486, 000
1903	56, 046, 000	3, 563, 000		59, 609, 000
1904	54, 927, 000	2, 800, 000		57, 727, 000
1905	59, 010, 000	2, 644, 000		61, 654, 000
1906	52, 139, 000	3, 847, 000		55, 986, 000
1907	63, 158, 000	4, 301, 000		67, 459, 000
1908	61, 473, 000	3, 646, 000		65, 119, 000
1909	58, 994, 000	3, 685, 000	9, 000	62, 688, 000
1910	62, 417, 000	3, 296, 000	22, 000	65, 735, 000
1911	67, 253, 000	3, 172, 000	17, 000	70, 442, 000
1912	62, 046, 000	3, 155, 000	28, 000	65, 229, 000
1913	69, 206, 000	2, 090, 000	47, 000	71, 343, 000
1914	68, 727, 000	1, 720, 000	17, 000	70, 464, 000
1915	66, 174, 000	2, 475, 000	17, 000	68, 666, 000
1916	64, 368, 000	3, 104, 000	29, 000	67, 501, 000
1917	72, 077, 000	5, 366, 000	47, 000	77, 490, 000
1918	70, 090, 000	6, 506, 000	125, 000	76, 721, 000
1919	64, 632, 000	3, 017, 000	323, 000	67, 972, 000
1920	63, 599, 000	4, 616, 000	396, 000	68, 611, 000
1921	67, 981, 000	1, 308, 000	265, 000	69, 554, 000
1922	37, 907, 000	2, 600, 000	567, 000	41, 074, 000
1923	69, 289, 000	3, 754, 000	385, 000	73, 428, 000

[a] Includes shipments from Sullivan County, except for 1891 to 1896, for which data are not available.

[b] In recent years, at least, a considerable tonnage of culm-bank coal has been handled in the breakers, so that the figures of shipments from washeries are less than the sales of culm-bank coal.

TREND OF SHIPMENTS BY SIZES

The relative proportions of the domestic and steam sizes shipped from one year to the next (fig. 55) depend largely on the state of the steam-coal market. The high tide of the shipments of the steam sizes came in 1918, when 31.5 per cent of the total dispatched from the anthracite region consisted of sizes smaller than pea. In 1921, on the contrary, depression in the steam-coal market caused the proportion to drop to 25.1 per cent, the lowest in many years. For 1922 and 1923 the proportion of the steam sizes was again above the average—29.0 and 28.2 per cent respectively—a condition that reflects the active demand in the winter of 1922–23.

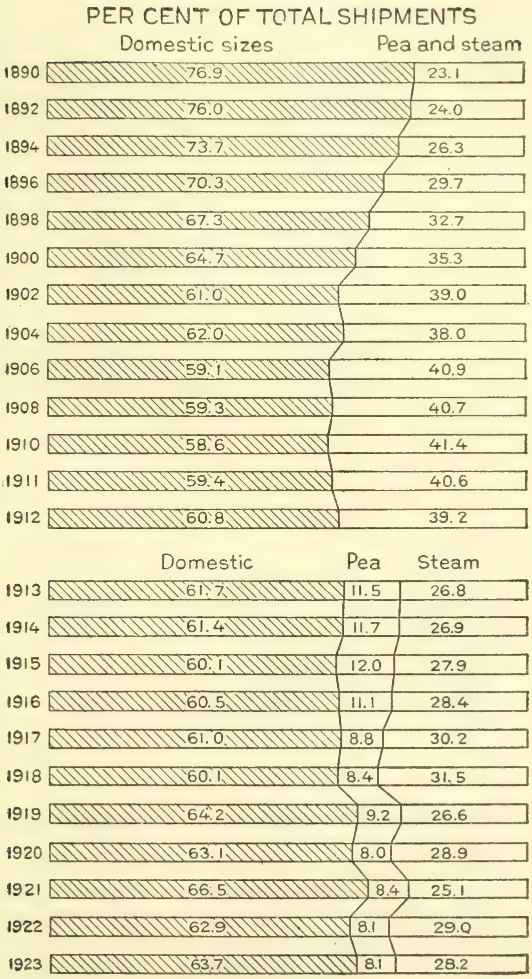

FIGURE 55.—Sizes of anthracite shipped from mines and washeries, 1890–1923. (Shipments from Sullivan County and dredges not included)

TABLE 126.—*Anthracite shipped from breakers and washeries, by sizes, 1890–1923* [a]

Year	Domestic		Pea and steam		Total (gross tons)
	Gross tons	Percentage of total	Gross tons	Percentage of total	
1890	28, 154, 000	76. 9	8, 461, 000	23. 1	36, 615, 000
1891	30, 604, 000	75. 7	9, 844, 000	24. 3	40, 448, 000
1892	31, 868, 000	76. 0	10, 025, 000	24. 0	41, 893, 000
1893	32, 294, 000	74. 9	10, 796, 000	25. 1	43, 090, 000
1894	30, 482, 000	73. 7	10, 909, 000	26. 3	41, 391, 000
1895	32, 469, 000	69. 9	14, 042, 000	30. 1	46, 511, 000
1896	30, 355, 000	70. 3	12, 822, 000	29. 7	43, 177, 000
1897	28, 510, 000	68. 5	13, 128, 000	31. 5	41, 638, 000
1898	28, 199, 000	67. 3	13, 701, 000	32. 7	41, 900, 000
1899	31, 507, 000	66. 1	16, 158, 000	33. 9	47, 665, 000
1900	29, 162, 000	64. 7	15, 945, 000	35. 3	45, 107, 000
1901	34, 413, 000	64. 2	19, 156, 000	35. 8	53, 569, 000
1902	19, 026, 000	61. 0	12, 175, 000	39. 0	31, 201, 000
1903	37, 739, 000	63. 6	21, 624, 000	36. 4	59, 363, 000
1904	35, 637, 000	62. 0	21, 856, 000	38. 0	57, 493, 000
1905	37, 425, 000	60. 9	23, 985, 000	39. 1	61, 410, 000
1906	32, 894, 000	59. 1	22, 805, 000	40. 9	55, 699, 000
1907	39, 333, 000	58. 6	27, 776, 000	41. 4	67, 109, 000
1908	38, 319, 000	59. 3	26, 346, 000	40. 7	64, 665, 000
1909	36, 205, 000	58. 3	25, 948, 000	41. 7	62, 153, 000
1910	38, 186, 000	58. 6	27, 008, 000	41. 4	65, 194, 000
1911	41, 476, 000	59. 4	28, 358, 000	40. 6	69, 834, 000
1912	39, 298, 000	60. 8	25, 369, 000	39. 2	64, 667, 000

Year	Domestic		Pea		Steam		Total (gross tons)
	Gross tons	Percentage of total	Gross tons	Percentage of total	Gross tons	Percentage of total	
1913	43, 689, 000	61. 7	8, 143, 000	11. 5	18, 927, 000	26. 8	70, 759, 000
1914	42, 952, 000	61. 4	8, 208, 000	11. 7	18, 770, 000	26. 9	69, 930, 000
1915	40, 993, 000	60. 1	8, 152, 000	12. 0	19, 017, 000	27. 9	68, 162, 000
1916	40, 556, 000	60. 5	7, 468, 000	11. 1	19, 006, 000	28. 4	67, 030, 000
1917	47, 003, 000	61. 0	6, 774, 000	8. 8	23, 239, 000	30. 2	77, 016, 000
1918	45, 795, 000	60. 1	6, 417, 000	8. 4	23, 972, 000	31. 5	76, 184, 000
1919	43, 166, 000	64. 2	6, 185, 000	9. 2	17, 925, 000	26. 6	67, 276, 000
1920	42, 784, 000	63. 1	5, 402, 000	8. 0	19, 607, 000	28. 9	67, 793, 000
1921	45, 906, 000	66. 5	5, 828, 000	8. 4	17, 318, 000	25. 1	69, 052, 000
1922	25, 334, 000	62. 9	3, 256, 000	8. 1	11, 707, 000	29. 0	40, 297, 000
1923	46, 330, 000	63. 7	5, 882, 000	8. 1	20, 550, 000	28. 2	72, 762, 000

[a] Exclusive of Sullivan County and dredge coal.

SHIPMENTS BY SIZES CLASSIFIED BY REGION AND BY METHOD OF PREPARATION

In Tables 127 and 128 are summarized the reports of operators as to quantity of each size shipped, classified by region and by method of preparation. The Geological Survey has collected no statistics of the sizes produced and used for colliery fuel or sold to local trade, and hence the figures may not be taken to represent accurately the proportion of the several sizes in the current production. They do, however, show the relative quantity of each size placed upon the market.

The great difference in the percentage of the prized domestic sizes in the breaker shipments as distinct from the washery shipments is brought out in Figure 56. Shipments of stove size constituted 19.6 per cent of the breaker shipments and only 2.9 per cent of the washery shipments in 1923, and the breaker percentage would doubtless be slightly higher if the culm-bank coal prepared in breakers and included in the breaker shipments could be eliminated.

The value of the shipments by sizes and the average value of each size per ton are given in Table 127.

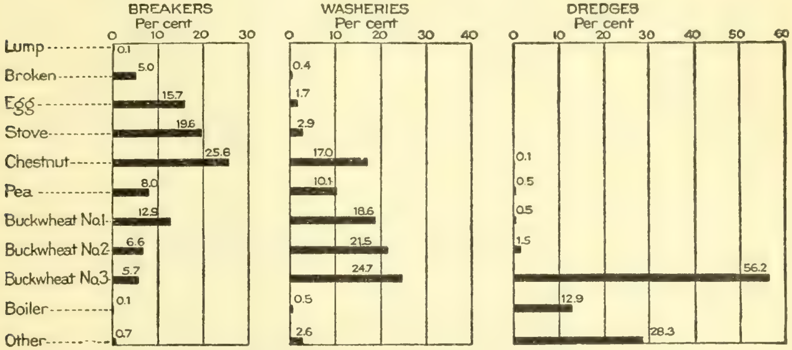

FIGURE 56.—Percentage of each size in shipments of anthracite from breakers, washeries, and dredges, 1923. The large percentage of "other" shown by the dredges includes a big tonnage reported as "river coal."

TABLE 127.—*Anthracite shipped, 1913–1923, by sizes* [a]

	Sizes above pea		Pea		Sizes below pea		Total (gross tons)
	Gross tons	Percentage of total	Gross tons	Percentage of total	Gross tons	Percentage of total	
1913: Breaker product [b]	43, 781, 936	63. 3	8, 056, 919	11. 6	17, 366, 691	25. 1	69, 205, 546
Total shipments	43, 935, 224	61. 6	8, 209, 479	11. 5	19, 198, 469	26. 9	71, 343, 172
1914: Breaker product [b]	43, 112, 545	62. 8	8, 142, 829	11. 8	17, 472, 101	25. 4	68, 727, 475
Total shipments	43, 176, 836	61. 3	8, 277, 619	11. 7	19, 009, 591	27. 0	70, 464, 046
1915: Breaker product [b]	41, 125, 513	62. 2	8, 011, 934	12. 1	17, 036, 370	25. 7	66, 173, 817
Total shipments	41, 213, 703	60. 0	8, 210, 668	12. 0	19, 242, 085	28. 0	68, 666, 456
1916: Breaker product [b]	40, 575, 269	63. 1	7, 223, 529	11. 2	16, 568, 956	25. 7	64, 367, 754
Total shipments	40, 747, 215	60. 4	7, 520, 804	11. 1	19, 233, 344	28. 5	67, 501, 363
1917: Breaker product [b]	46, 640, 319	64. 7	6, 298, 870	8. 7	19, 138, 145	26. 6	72, 077, 334
Total shipments	47, 195, 895	60. 9	6, 824, 003	8. 8	23, 470, 145	30. 3	77, 490, 043
1918: Breaker product [b]	45, 323, 253	64. 7	5, 798, 401	8. 3	18, 968, 580	27. 0	70, 090, 234
Total shipments	45, 994, 903	60. 0	6, 471, 381	8. 4	24, 254, 873	31. 6	76, 721, 157
1919: Breaker product [b]	42, 937, 454	66. 4	5, 884, 492	9. 1	15, 809, 757	24. 5	64, 631, 703
Total shipments	43, 349, 551	63. 8	6, 237, 398	9. 2	18, 385, 346	27. 0	67, 972, 295
1920: Breaker product [b]	42, 209, 170	66. 4	5, 008, 050	7. 9	16, 381, 463	25. 7	63, 598, 683
Total shipments	42, 984, 656	62. 6	5, 457, 588	8. 0	20, 168, 519	29. 4	68, 610, 763
1921: Breaker product [b]	45, 796, 115	67. 4	5, 720, 904	8. 4	16, 464, 397	24. 2	67, 981, 416
Total shipments	46, 051, 199	66. 2	5, 865, 379	8. 4	17, 637, 985	25. 4	69, 554, 563
1922: Breaker product [b]	25, 046, 679	66. 1	2, 967, 355	7. 8	9, 892, 469	26. 1	37, 906, 503
Total shipments	25, 409, 723	61. 8	3, 278, 136	8. 0	12, 385, 979	30. 2	41, 073, 838
1923: Breaker product [b]	45, 651, 693	65. 9	5, 544, 915	8. 0	18, 091, 818	26. 1	69, 288, 426
Total shipments	46, 479, 297	63. 3	5, 928, 618	8. 1	21, 019, 797	28. 6	73, 427, 712

[a] Includes shipments of dredge coal.

[b] Formerly reported under the caption "Freshly mined coal." Includes a considerable tonnage of culm-bank coal handled in the breakers.

TABLE 128.—*Anthracite shipped, 1922–23, by regions and sizes, in gross tons*

[The figures of shipments from breakers include a considerable tonnage of culm-bank coal handled in the breakers]

Size	Lehigh region			Schuylkill region			Wyoming region			Sullivan County breakers	Total	
	Breakers	Washeries	Dredges	Breakers	Washeries	Dredges	Breakers	Washeries	Dredges		Quantity	Percentage of total
1922												
Lump				4, 151							4, 151	
Broken	95, 624	870		388, 775	3, 805		1, 139, 319	2, 072		8, 809	1, 639, 274	4. 0
Egg	676, 811	5, 756		1, 244, 818	5, 347		3, 533, 052	7, 794		13, 453	5, 487, 031	13. 4
Stove	1, 001, 658	3, 821		2, 202, 377	9, 690		4, 929, 689	25, 162		20, 910	8, 193, 307	19. 9
Chestnut	1, 349, 259	47, 902		2, 754, 717	126, 935		5, 650, 905	123, 890		32, 352	[a]10, 085, 960	24. 6
Pea	602, 358	19, 734	979	977, 718	211, 724	487	1, 368, 144	75, 726	2, 131	19, 135	3, 278, 136	8. 0
Buckwheat No. 1	782, 840	22, 618	2, 210	1, 782, 928	417, 811	1, 368	2, 381, 500	143, 835	2, 485		5, 537, 595	13. 5
Buckwheat No. 2 (rice)	415, 009	22, 329	111	689, 348	259, 696	30, 220	1, 378, 857	179, 421	1, 296		[b]2, 976, 287	7. 2
Buckwheat No. 3 (barley)	358, 097	103, 682	26, 547	858, 334	443, 401	89, 937	745, 350	216, 527			2, 841, 875	6. 9
Boiler	13, 776		61, 281	22, 039	1, 638	33, 405	92, 757	6, 297	40, 324		271, 517	. 7
Other [c]	37, 840	15, 721		105, 643	66, 648	274, 073	112, 331	30, 629		115, 820	758, 705	1. 8
	5, 333, 272	242, 433	91, 128	11, 030, 848	1, 546, 695	429, 490	21, 331, 904	811, 353	46, 236	210, 479	41, 073, 838	100. 0
1923												
Lump				7, 082							7, 082	
Broken	166, 216	2, 773		716, 682	3, 047		2, 565, 411	8, 367		14, 086	3, 476, 582	4. 7
Egg	1, 405, 101	16, 305		2, 554, 068	7, 295		6, 912, 353	39, 918		27, 954	10, 962, 994	14. 9
Stove	1, 697, 987	12, 626		3, 661, 617	17, 541		8, 161, 395	80, 074		46, 144	13, 677, 384	18. 6
Chestnut	2, 425, 775	46, 856		4, 756, 618	259, 318	206	10, 472, 092	333, 278		61, 112	[d]18, 355, 255	25. 0
Pea	912, 632	32, 985	291	2, 038, 969	191, 355	236	2, 548, 984	157, 417	1, 419	44, 330	5, 928, 618	8. 1
Buckwheat No. 1	1, 367, 965	70, 577	433	3, 439, 731	343, 209	1, 261	4, 133, 733	284, 328	334		9, 641, 571	13. 2
Buckwheat No. 2 (rice)	700, 958	80, 620		1, 296, 794	309, 528	5, 600	2, 560, 927	417, 002			5, 371, 429	7. 3
Buckwheat No. 3 (barley)	731, 739	219, 449	59, 876	1, 735, 007	411, 960	156, 428	1, 507, 814	295, 312			5, 117, 585	7. 0
Boiler	14, 426		34, 125	2, 710	14	12, 043	85, 529	17, 554	3, 839		170, 240	. 2
Other [e]	115, 348	39, 553		168, 105	9, 244	108, 908	143, 836	46, 782		87, 196	718, 972	1. 0
	9, 538, 147	521, 744	94, 725	20, 377, 383	1, 552, 511	284, 682	39, 092, 074	1, 680, 032	5, 592	280, 822	73, 427, 712	100. 0

[a] Includes 579,898 tons of "range" coal, reported by 8 operators.
[b] Includes 581,557 tons of "birdseye" coal, reported by 11 operators.
[c] Includes run-of-mine, silt, culm, buckwheat No. 4, and screenings.
[d] Includes 2,328,843 tons of "range" coal.
[e] Includes culm, buckwheat No. 4, silt, run-of-mine, and "river" coal.

TABLE 129.—*Value of anthracite shipped, 1922–23, by regions and sizes* [a]

[The figures of shipments from breakers include a considerable tonnage of culm-bank coal handled in the breakers]

Size	Lehigh region						Schuylkill region					
	Breakers		Washeries		Dredges		Breakers		Washeries		Dredges	
	Total	Average per ton	Total	Average per ton	Total	Average per ton	Total	Average per ton	Total	Average per ton	Total	Average per ton
1922												
Lump							$31,966	$7.70				
Broken	$739,087	$7.73	$6,656	$7.65			3,226,665	8.30	$32,034	$8.42		
Egg	5,433,193	8.03	46,455	8.07			10,111,286	8.12	43,988	8.23		
Stove	8,074,057	8.06	31,210	8.17			18,214,259	8.27	78,828	8.13		
Chestnut	10,830,492	8.03	395,306	8.25			22,806,387	8.28	1,056,231	8.32		
Pea	3,571,003	5.93	121,868	6.18	$5,140	$5.25	5,934,244	6.07	1,247,669	5.89	$2,633	$5.41
Buckwheat No. 1	2,866,769	3.66	87,573	3.87	4,745	2.15	6,242,872	3.50	1,422,273	3.40	3,855	2.82
Buckwheat No. 2 (rice)	1,061,351	2.55	60,834	2.72	302	2.72	1,578,288	2.29	584,536	2.25	61,310	2.03
Buckwheat No. 3 (barley)	626,324	1.75	184,716	1.78	30,423	1.15	1,285,025	1.50	653,780	1.47	104,036	1.16
Boiler	4,728	.34			65,707	1.07	9,717	.44	2,051	1.25	37,586	1.12
Other	33,553	.89	11,703	.74			54,623	.52	52,533	.79	296,418	1.02
	33,240,557	6.23	946,321	3.90	106,317	1.17	69,495,332	6.30	5,173,923	3.34	505,838	1.18
1923												
Lump							59,123	8.35				
Broken	1,332,154	8.01	21,680	7.82			6,299,891	8.79	28,792	9.45		
Egg	12,221,643	8.69	136,044	8.34			22,609,583	8.85	65,185	8.94		
Stove	14,687,845	8.65	105,556	8.36			32,493,826	8.87	152,146	8.67		
Chestnut	20,851,822	8.60	388,127	8.28			42,136,250	8.86	2,395,854	9.24	1,825	8.85
Pea	5,789,990	6.34	204,318	6.19	1,526	5.24	12,951,142	6.35	1,189,452	6.21	1,636	6.93
Buckwheat No. 1	4,929,884	3.60	256,740	3.64	974	2.25	11,784,734	3.43	1,156,898	3.37	4,551	3.61
Buckwheat No. 2 (rice)	1,746,908	2.49	203,760	2.53			2,823,608	2.18	651,486	2.10	12,208	2.18
Buckwheat No. 3 (barley)	1,134,835	1.55	327,431	1.49	81,088	1.35	2,350,249	1.35	540,244	1.31	158,152	1.01
Boiler	5,511	.38			40,950	1.20	948	.35	5	.38	11,026	.92
Other	81,508	.71	32,000	.81			126,013	.75	5,307	.57	116,786	1.07
	62,782,100	6.58	1,675,656	3.21	124,538	1.31	133,635,367	6.56	6,185,369	3.98	306,184	1.08

[a] Value given is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated selling companies.

TABLE 129.—*Value of anthracite shipped, 1922–23, by regions and sizes*—Continued

Size	Wyoming region						Sullivan County		All regions	
	Breakers		Washeries		Dredges		Breakers			
	Total	Average per ton	Total	Average per ton	Total	Average per ton	Total	Average per ton	Total	Average per ton
1922										
Lump									$31, 966	$7. 70
Broken	$8, 456, 611	$7. 42	$14, 828	$7. 16			$64, 106	$7. 28	12, 539, 987	7. 65
Egg	27, 572, 571	7. 80	58, 937	7. 56			131, 322	9. 76	43, 397, 752	7. 91
Stove	38, 984, 301	7. 91	229, 291	9. 11			183, 738	8. 79	65, 795, 684	8. 03
Chestnut	44, 999, 440	7. 96	1, 010, 671	8. 16			306, 237	9. 46	[b] 81, 404, 764	8. 07
Pea	7, 941, 025	5. 80	447, 187	5. 91	$11, 802	$5. 54	133, 279	6. 97	19, 415, 850	5. 92
Buckwheat No. 1	8, 523, 555	3. 58	516, 810	3. 59	7, 688	3. 09			19, 676, 140	3. 55
Buckwheat No. 2 (rice)	3, 240, 995	2. 35	472, 224	2. 63	662	. 51			[c] 7, 060, 502	2. 37
Buckwheat No. 3 (barley)	1, 172, 117	1. 57	393, 717	1. 82					4, 450, 138	1. 57
Boiler	193, 762	2. 09	16, 224	2. 58	74, 040	1. 84			403, 815	1. 49
Other	217, 561	1. 94	31, 482	1. 03			280, 067	2. 42	977, 940	1. 28
	141, 301, 938	6. 62	3, 191, 371	3. 93	94, 192	2. 04	1, 098, 749	5. 22	255, 154, 538	6. 21
1923										
Lump									59, 123	8. 35
Broken	19, 415, 267	7. 57	59, 892	7. 16			122, 366	8. 69	27, 280, 042	7. 85
Egg	57, 435, 625	8. 31	305, 408	7. 65			253, 300	9. 06	93, 026, 788	8. 49
Stove	68, 551, 727	8. 40	678, 368	8. 47			429, 565	9. 31	117, 099, 033	8. 56
Chestnut	87, 469, 766	8. 35	2, 856, 871	8. 57			582, 140	9. 53	[d] 156, 682, 655	8. 54
Pea	15, 192, 848	5. 96	907, 968	5. 77	4, 257	3. 00	316, 472	7. 14	36, 559, 609	6. 17
Buckwheat No. 1	14, 390, 950	3. 48	980, 783	3. 45	167	. 50			33, 505, 681	3. 48
Buckwheat No. 2 (rice)	5, 585, 362	2. 18	921, 924	2. 21					11, 945, 256	2. 22
Buckwheat No. 3 (barley)	2, 111, 229	1. 40	446, 836	1. 51					7, 150, 064	1. 40
Boiler	142, 051	1. 66	24, 242	1. 38	1, 052	. 27			225, 785	1. 33
Other	260, 203	1. 81	33, 606	. 72			208, 698	2. 39	864, 121	1. 20
	270, 555, 028	6. 92	7, 215, 898	4. 30	5, 476	. 98	1, 912, 541	6. 81	484, 398, 157	6. 60

[b] Includes $5,288,017, value of "range" coal.

[c] Includes $1,342,528, value of "birdseye coal."

[d] Includes $20,179,951, value of "range" coal.

SPOT PRICES AND AVERAGE RECEIPTS F. O. B. MINES

For purposes of reference, the current prices of company and independent stove and buckwheat No. 3, f. o. b. mines, as quoted by Coal Age in the New York market, are charted in Figure 30. The average receipts on all sizes are shown for each region in Table 130.

TABLE 130.—*Average value per gross ton of anthracite shipped, local sales, colliery fuel, and total production, by regions, 1918–1923* [a]

Year and region	Shipments	Local sales	Colliery fuel	Total	Year and region	Shipments	Local sales	Colliery fuel	Total
1918					**1921**				
Lehigh	$4.01	$2.68	$1.36	$3.71	Lehigh	$6.13	$3.50	$1.59	$5.54
Schuylkill	4.13	3.33	.91	3.67	Schuylkill	6.03	4.19	.65	5.22
Wyoming	4.18	3.39	1.45	3.92	Wyoming	6.29	5.64	1.27	5.82
Sullivan County	3.97	3.99	2.29	3.79	Sullivan County	6.21	6.20	2.30	5.53
	4.14	3.25	1.23	3.81		6.20	4.75	1.08	5.60
1919					**1922**				
Lehigh	4.86	3.37	1.80	4.51	Lehigh	6.05	3.97	2.34	5.56
Schuylkill	4.94	3.43	.85	4.31	Schuylkill	5.78	4.44	.78	4.98
Wyoming	5.21	4.55	1.55	4.85	Wyoming	6.52	5.78	1.69	6.02
Sullivan County	4.63	4.70	2.29	4.36	Sullivan County	5.22	6.18	2.00	4.84
	5.08	3.98	1.32	4.64		6.21	5.07	1.38	5.61
1920					**1923**				
Lehigh	5.88	3.29	1.94	5.34	Lehigh	6.36	3.80	1.77	5.84
Schuylkill	5.70	4.14	.90	4.99	Schuylkill	6.31	3.87	.72	5.63
Wyoming	6.15	5.17	1.80	5.71	Wyoming	6.81	5.92	1.43	6.40
Sullivan County	5.60	5.71	2.33	5.27	Sullivan County	6.81	6.56	2.60	6.73
	5.97	4.44	1.47	5.43		6.60	4.80	1.21	6.08

[a] Value given for shipments is value at which coal left possession of producing company f. o. b. mines and does not include margins of separately incorporated selling companies.

LABOR STATISTICS

No significant change in the average number of employees in the anthracite mines occurred during 1923. The total number of men and boys, excluding officials and office force, was 157,743, against 156,849 in 1922 (Table 131). The average number of days worked in 1923 was 268, slightly less than in 1921. The working year was shortened by the brief suspension in September at the expiration of the wage agreement, the effects of which are shown in the time lost because of labor controversies (Table 132).

TABLE 131.—*Number of employees and days worked in the anthracite field, 1922–23, by regions*

Region	Average number employed					Average number of days worked
	Surface	Underground			Total	
		Miners [a]	All others	Total		
1922						
Lehigh:						
Breakers [b]	6,160	8,127	5,647	13,774	19,934	157
Washeries	228				228	99
Dredges	18				18	125
	6,406	8,127	5,647	13,774	20,180	156
Schuylkill:						
Breakers [b]	15,448	20,909	12,038	32,947	48,395	156
Washeries	1,016				1,016	130
Dredges	311				311	174
	16,775	20,909	12,038	32,947	49,722	155
Wyoming:						
Breakers [b]	18,436	43,163	23,909	67,072	85,508	147
Washeries	678				678	156
Dredges	19				19	131
	19,133	43,163	23,909	67,072	86,205	147
Sullivan County:						
Breakers [b]	256	328	158	486	742	113
Total breakers [b]	[c] 40,300	72,527	41,752	114,279	154,579	151
Total washeries	1,922				1,922	136
Total dredges	348				348	169
Grand total	42,570	72,527	41,752	114,279	156,849	151
1923						
Lehigh:						
Breakers	6,423	8,189	5,714	13,903	20,326	274
Washeries	299				299	191
Dredges	14				14	153
	6,736	8,189	5,714	13,903	20,639	273
Schuylkill:						
Breakers	15,062	20,860	11,717	32,577	47,639	275
Washeries	1,354				1,354	226
Dredges	357				357	207
	16,773	20,860	11,717	32,577	49,350	273
Wyoming:						
Breakers	18,308	42,956	24,750	67,706	86,014	264
Washeries	961				961	211
Dredges	3				3	98
	19,272	42,956	24,750	67,706	86,978	264
Sullivan County:						
Breakers	241	357	178	535	776	241
Total breakers	[c] 40,034	72,362	42,359	114,721	154,755	269
Total washeries	2,614				2,614	216
Total dredges	374				374	204
Grand total	43,022	72,362	42,359	114,721	157,743	268

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[a] Operators were requested to give number of "all miners (contract, consideration, and company) and their laborers."

[b] Formerly presented under caption "Freshly-mined coal." A considerable tonnage of culm-bank coal, however, is handled in the breakers.

[c] Includes a comparatively small number of washery employees who could not be separated from breaker employees.

TABLE 132.—*Strikes, suspensions, and lockouts in the Pennsylvania anthracite region, 1919–1923*

	Lehigh	Schuylkill	Wyoming	Sullivan County	Total
1919					
Total number employed	19,164	47,535	87,046	826	154,571
Men on strike	6,518	4,212	24,409	----------	35,139
Man-days lost account strike	26,868	15,787	192,898	----------	235,553
Average days lost:					
Per man employed	1	0.3	2	----------	2
Per man on strike	4	4	8	----------	7
1920					
Total number employed	18,996	46,324	78,978	776	145,074
Men on strike	15,666	41,945	39,229	----------	96,840
Man-days lost account strike	230,734	695,056	889,526	----------	1,815,316
Average days lost:					
Per man employed	12	15	11	----------	13
Per man on strike	15	17	23	----------	19
1921					
Total number employed	20,727	49,761	88,240	771	159,499
Men on strike	10,847	5,523	35,747	----------	52,117
Man-days lost account strike	191,133	24,906	607,240	----------	823,279
Average days lost:					
Per man employed	9	0.5	7	----------	5
Per man on strike	18	5	17	----------	16
1922					
Total number employed	20,180	49,722	86,205	742	156,849
Men on strike	19,066	41,893	80,753	730	142,442
Man-days lost account strike	2,615,717	5,734,852	11,167,109	105,348	19,623,026
Average days lost:					
Per man employed	130	115	130	142	125
Per man on strike	137	137	138	144	138
1923					
Total number employed	20,639	49,350	86,978	776	157,743
Men on strike	18,593	43,524	72,772	696	135,585
Man-days lost account strike	354,830	805,640	1,456,364	12,584	2,629,418
Average days lost:					
Per man employed	17	16	17	16	17
Per man on strike	19	19	20	18	19

MINING METHODS

The use of undercutting machines, now so general in the bituminous-coal mines, has made little progress in the face of the greater natural difficulties in the anthracite mines. Machines are employed only in the gently dipping beds of the Wyoming region and Sullivan County, and the total mined by machine in 1923—1,079,055 tons—was only 1.4 per cent of the breaker output.

Strip mining, on the other hand, has assumed greater importance in relation to the total output in the anthracite than in the bituminous-coal mines. The anthracite mined by stripping in 1923 was 2,020,623 tons, or 2.6 per cent of the total breaker product; the corresponding figure for bituminous-coal mining was 2.1 per cent.

TABLE 133.—*Pennsylvania anthracite mined by machines, 1921–1923*

Region	1921		1922		1923	
	Number of machines	Gross tons	Number of machines	Gross tons	Number of machines	Gross tons
Wyoming	97	636,021	82	448,922	147	962,058
Sullivan County	17	238,216			15	116,997
	114	874,237	82	448,922	162	1,079,055

TABLE 134.—*Pennsylvania anthracite recovered from steam-shovel strip pits, 1921–1923*

Region	1921		1922		1923	
	Number of shovels	Gross tons	Number of shovels	Gross tons	Number of shovels	Gross tons
Lehigh	29	865,877	33	453,727	38	1,066,517
Schuylkill	34	680,869	24	345,815	37	761,135
Wyoming	22	263,781	12	48,445	20	192,971
	85	1,810,527	69	847,987	95	2,020,623

DREDGE OPERATIONS

In 1923, 60 dredges reported to the Geological Survey a production of 853,900 gross tons, with a value of $811,065. The figures are possibly incomplete. The output of the dredges is shown in the tables of this report, apportioned between the Schuylkill, Lehigh, and Wyoming regions, but this apportionment is necessarily arbitrary, for many of the dredges are working at points distant from the mines. The recapitulation by rivers in Table 135 will indicate more clearly where the dredge coal is recovered.

The seasonal nature of dredging is shown by the table of number of employees in each month (Table 136). In June, when the maximum was reached, the number of men at work was 504, or two and a half times as many as the minimum in January.

TABLE 135.—*Anthracite produced by dredges, 1923, by rivers*

River (including tributaries)	Number of dredges	Gross tons	Value
Lehigh	3	94,725	$124,538
Schuylkill	14	86,834	132,159
Susquehanna	43	672,341	554,368
	60	853,900	$811,065

TABLE 136.—*Number of employees on pay rolls of anthracite dredge operations on the first day of each month, 1922–23*

	Lehigh district	Schuylkill district	Wyoming district	Total		Lehigh district	Schuylkill district	Wyoming district	Total
1922					**1923**				
January	--------	121	17	138	January	--------	200	--------	200
February	--------	139	17	156	February	--------	203	--------	203
March	--------	251	17	268	March	--------	286	--------	286
April	7	343	17	367	April	4	421	--------	425
May	10	411	17	438	May	18	477	5	500
June	20	429	26	475	June	23	476	5	504
July	18	449	25	492	July	21	445	5	471
August	20	431	20	471	August	23	404	5	432
September	50	416	20	486	September	24	390	5	419
October	39	286	17	342	October	18	374	5	397
November	34	216	17	267	November	18	315	--------	333
December	10	163	17	190	December	17	263	--------	280
Average	18	311	19	348	Average	14	357	3	374

BITUMINOUS COAL

In Pennsylvania, as in Illinois, Indiana, and Ohio, the amount of coal raised in 1923 made the fourth best record in the annals of the State. The years in which a greater tonnage was mined were 1913, 1917, and 1918, but 1923 was unusual in that every county showed an increase, the output of wagon mines alone falling off. The production rose from 113,148,308 tons in 1922 to 171,879,913 tons in 1923, a gain of 58,731,605 tons, or nearly 52 per cent. There was but one State that showed a greater percentage of increase in production—Maryland—and one other that approximated this percentage—Ohio. In Maryland the value also showed a larger rate of gain.

The total value in 1923 was $472,217,000, which was $120,440,000, or 34.2 per cent, greater than in 1922. The spot prices in the Somerset, Clearfield, and Pittsburgh districts for a series of years and for the months of 1923 are charted in Figure 57. Since 1918, when the rate per ton was the same for the coals of the Somerset and Clearfield districts, the curves for these districts have run practically parallel. The Pittsburgh price generally ran lower than that for the Clearfield district; but in 1921 it exceeded the Clearfield price by 1 cent ($2.25 as compared with $2.24), and in September and December, 1923, by 7 cents and 14 cents, respectively. In Pennsylvania, as in other States, prices were falling throughout most of 1923.

Because Pennsylvania has a much greater productive capacity than any other State, its output can not be plotted on the same scale as even Illinois and West Virginia; hence the break in the diagram of average daily production. In 1918 the average was 580,000 tons, and in 1922 as a whole it was 369,000 tons. In January, 1923, transportation disability limited the output of coal, but this obstacle was overcome in the following months, and production rose steadily till August, when the top notch was reached at a daily average of 622,000 tons; then the lack of a market caused operations to slow down, and the graph shows a precipitate decline to the end of the year. The average for 1923 as a whole was 562,000 tons.

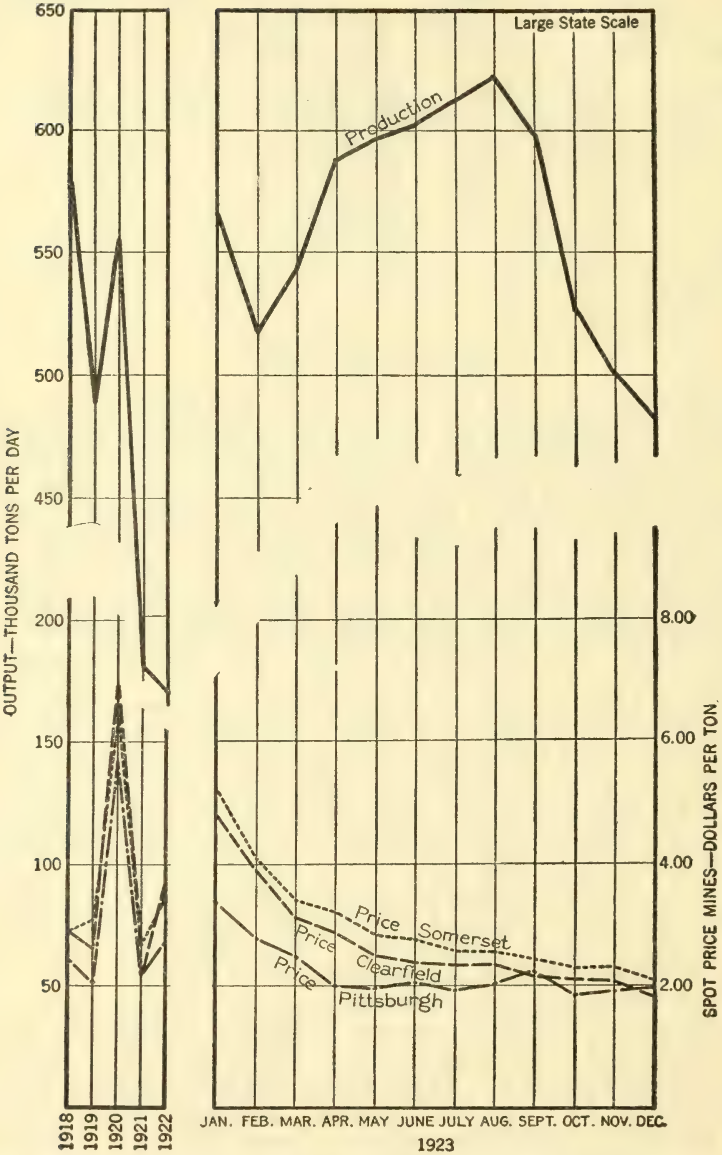

FIGURE 57.—Production of bituminous coal per working day in Pennsylvania and trend of spot prices, run-of-mine grade, in Pittsburgh, Clearfield, and Somerset districts, 1918–1923. Data from Tables 78 and 79; spot prices as quoted by Coal Age

TABLE 137.—*Bituminous coal produced in Pennsylvania, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1922												
Allegheny	9, 133, 964	1, 751, 229	138, 018		11, 023, 211	$35, 726, 000	$3. 24	12, 306	4, 379	2, 954	19, 639	129
Armstrong	2, 950, 159	224, 952	90, 737		3, 265, 848	10, 252, 000	3. 14	4, 866	1, 280	1, 121	7, 267	118
Beaver	167, 210	39, 554	20, 195		226, 959	769, 000	3. 39	205	32	106	343	218
Bedford	293, 663	12, 795	10, 112	23, 864	340, 434	1, 242, 000	3. 65	839	325	210	1, 374	92
Blair	67, 334	12, 835	1, 252	16, 785	98, 206	321, 000	3. 27	219	57	30	306	110
Bradford	6, 480	1, 404	20		7, 904	26, 000	3. 35	12	4	6	22	156
Butler	1, 751, 428	57, 529	29, 004		1, 837, 961	6, 353, 000	3. 46	1, 816	543	417	2, 776	201
Cambria	10, 802, 775	1, 007, 287	168, 469	978, 784	12, 957, 315	43, 761, 000	3. 38	15, 514	4, 981	2, 908	23, 403	139
Center	1, 154, 406	48, 865	4, 588		1, 207, 859	3, 776, 000	3. 13	1, 620	426	273	2, 319	143
Clarion	1, 165, 537	133, 640	21, 292		1, 320, 469	4, 265, 000	3. 23	2, 047	514	390	2, 951	144
Clearfield	5, 116, 864	204, 338	80, 572	54, 585	5, 456, 359	17, 437, 000	3. 20	8, 780	2, 377	1, 528	12, 685	120
Clinton	112, 609	31, 854	1, 687		146, 150	508, 000	3. 48	207	66	62	335	172
Elk	815, 089	10, 819	29, 197		855, 105	2, 717, 000	3. 19	1, 247	283	257	1, 787	131
Fayette	11, 590, 168	225, 224	600, 367	5, 344, 017	17, 759, 776	49, 876, 000	2. 81	11, 651	9, 598	5, 712	26, 961	187
Greene	2, 274, 886	27, 988	45, 653		2, 348, 527	7, 443, 000	3. 17	1, 244	1, 256	628	3, 128	229
Huntingdon	381, 056	6, 530	9, 564		397, 150	1, 818, 000	4. 58	1, 009	273	141	1, 423	93
Indiana	7, 118, 153	137, 469	100, 209	265, 000	7, 620, 831	23, 645, 000	3. 10	8, 771	2, 513	1, 729	13, 013	148
Jefferson	2, 513, 177	100, 520	83, 125	203, 613	2, 900, 435	9, 868, 000	3. 40	3, 990	1, 065	765	5, 820	136
Lawrence	174, 362	24, 827	9, 718		208, 907	587, 000	2. 81	206	75	44	325	253
Mercer	429, 859	6, 042	21, 552		457, 453	1, 438, 000	3. 14	664	215	115	994	181
Somerset	7, 312, 316	188, 307	127, 630		7, 628, 253	25, 151, 000	3. 30	7, 466	2, 485	1, 690	11, 641	185
Tioga	338, 520	28, 508	7, 126		374, 154	1, 476, 000	3. 95	898	165	163	1, 226	131
Washington	12, 070, 000	298, 088	188, 296	16, 093	12, 572, 477	37, 103, 000	2. 95	15, 333	5, 510	3, 387	24, 230	115
Westmoreland	15, 708, 165	545, 098	425, 700	3, 960, 730	20, 639, 693	58, 898, 000	2. 85	13, 544	6, 463	4, 735	24, 742	201
Other counties [b]	45, 328	4, 846	508		50, 682	235, 000	4. 64	87	25	16	128	140
Total, excluding wagon mines	93, 493, 508	5, 130, 548	2, 214, 591	10, 863, 471	111, 702, 118	344, 691, 000	3. 09	114, 541	44, 910	29, 387	188, 838	154
Wagon mines served by rail	1, 446, 190				1, 446, 190	7, 086, 000	4. 90					
Grand total	94, 939, 698	5, 130, 548	2, 214, 591	10, 863, 471	113, 148, 308	351, 777, 000	3. 11					

[a] Includes also loaders and shot firers.

[b] Cameron, Fulton, Lycoming, and McKean.

TABLE 137.—*Bituminous coal produced in Pennsylvania, 1922–23*—Continued

County	Net tons					Value		Number of employees				Average number of days worked
								Underground				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Miners [a]	All others	Surface	Total	
1923												
Allegheny	18, 198, 211	1, 866, 052	159, 976		20, 224, 239	$54, 521, 000	$2. 70	13, 495	4, 344	2, 788	20, 627	233
Armstrong	4, 651, 674	262, 491	147, 567		5, 061, 732	13, 710, 000	2. 71	4, 844	1, 275	1, 038	7, 157	172
Beaver	166, 820	55, 700	24, 551		247, 071	694, 000	2. 80	199	37	99	335	220
Bedford	431, 760	16, 864	13, 521	135, 351	597, 496	1, 849, 000	3. 09	835	303	142	1, 280	148
Blair	109, 682	22, 184	2, 023	35, 387	169, 276	516, 000	3. 05	226	40	36	302	169
Bradford	9, 315	865	150		10, 330	36, 000	3. 48	13	4	13	30	158
Butler	1, 765, 161	66, 276	24, 882		1, 856, 319	4, 991, 000	2. 69	1, 949	606	422	2, 977	177
Cambria	16, 627, 417	2, 641, 876	191, 671	290, 501	19, 751, 465	59, 213, 000	3. 00	16, 467	4, 811	2, 874	24, 152	197
Center	1, 292, 977	62, 247	1, 279		1, 356, 503	3, 897, 000	2. 87	1, 638	403	244	2, 285	162
Clarion	1, 792, 996	93, 290	14, 263		1, 900, 549	4, 726, 000	2. 49	2, 007	507	375	2, 889	193
Clearfield	6, 977, 477	274, 436	101, 429	192, 716	7, 546, 058	20, 939, 000	2. 77	8, 845	2, 250	1, 497	12, 592	166
Clinton	209, 037	47, 650	3, 864		260, 551	642, 000	2. 46	156	59	93	308	205
Elk	1, 089, 871	18, 423	38, 831		1, 147, 125	3, 385, 000	2. 95	1, 430	256	232	1, 918	193
Fayette	15, 121, 722	389, 108	691, 877	15, 963, 254	32, 165, 961	89, 307, 000	2. 78	13, 887	11, 549	5, 897	31, 333	248
Greene	3, 808, 070	27, 595	50, 847	95, 491	3, 982, 003	10, 829, 000	2. 72	1, 758	1, 364	724	3, 846	258
Huntingdon	711, 901	10, 478	21, 803	13, 496	757, 678	2, 798, 000	3. 69	1, 010	264	108	1, 382	198
Indiana	9, 764, 471	209, 069	86, 245	415, 514	10, 475, 299	28, 521, 000	2. 72	8, 847	2, 515	1, 699	13, 061	192
Jefferson	3, 649, 007	85, 436	92, 805	554, 445	4, 381, 693	11, 851, 000	2. 71	3, 995	1, 061	685	5, 741	191
Lawrence	218, 927	52, 960	9, 821		281, 708	905, 000	3. 21	241	85	44	370	282
Mercer	430, 098	13, 167	22, 084		465, 349	1, 409, 000	3. 03	597	191	113	901	178
Somerset	8, 207, 293	194, 418	128, 907		8, 530, 618	25, 379, 000	2. 97	7, 827	2, 527	1, 766	12, 120	185
Tioga	437, 736	34, 384	8, 215		480, 335	1, 813, 000	3. 77	773	164	148	1, 085	192
Washington	23, 520, 756	286, 865	232, 276	459, 206	24, 499, 103	61, 406, 000	2. 51	15, 436	5, 264	3, 075	23, 775	220
Westmoreland	18, 765, 751	622, 787	437, 353	5, 582, 979	25, 408, 870	67, 706, 000	2. 66	13, 824	6, 276	4, 290	24, 390	235
Other counties [b]	78, 046	4, 592	987		83, 625	326, 000	3. 90	86	28	11	125	229
Total, excluding wagon mines	138, 036, 176	7, 359, 213	2, 507, 227	23, 738, 340	171, 640, 956	471, 369, 000	2. 74	120, 385	46, 183	28, 413	194, 981	213
Wagon mines served by rail	238, 957				238, 957	848, 000	3. 55					
Grand total	138, 275, 133	7, 359, 213	2, 507, 227	23, 738, 340	171, 879, 913	472, 217, 000	2. 75					

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[a] Includes also loaders and shot firers.

[b] Cameron, Fulton, Lycoming, and McKean.

TABLE 138.—*Bituminous coal produced in Pennsylvania, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Allegheny	14, 856, 781	16, 047, 575	11, 931, 527	11, 023, 211	20, 224, 239	+9, 201, 028
Armstrong	4, 665, 232	5, 975, 063	3, 388, 762	3, 265, 848	5, 061, 732	+1, 795, 884
Beaver	139, 294	170, 900	161, 409	226, 959	247, 071	+20, 112
Bedford	704, 289	785, 903	317, 244	340, 434	597, 496	+257, 062
Blair	181, 209	158, 257	92, 144	98, 206	169, 276	+71, 070
Bradford	[a] 13, 373	[a] 67, 932	[a] 55, 296	7, 904	10, 330	+2, 426
Butler	1, 128, 192	1, 542, 307	923, 391	1, 837, 961	1, 856, 319	+18, 358
Cambria	16, 899, 818	18, 967, 754	16, 339, 228	12, 957, 315	19, 751, 465	+6, 794, 150
Cameron and McKean	([c])	----------	([a] [b])	[b] 50, 682	[b] 83, 625	+[b] 32, 943
Center	1, 296, 061	1, 735, 045	764, 994	1, 207, 859	1, 356, 503	+148, 644
Clarion	1, 393, 647	1, 567, 095	1, 248, 294	1, 320, 469	1, 900, 549	+580, 080
Clearfield	7, 573, 392	9, 242, 416	5, 853, 922	5, 456, 359	7, 546, 058	+2, 089, 699
Clinton	288, 100	327, 296	83, 641	146, 150	260, 551	+114, 401
Elk	947, 595	1, 258, 834	878, 201	855, 105	1, 147, 125	+292, 020
Fayette	29, 660, 105	30, 742, 236	19, 260, 778	17, 759, 776	32, 165, 961	+14, 406, 185
Greene	1, 423, 118	2, 078, 835	2, 294, 801	2, 348, 527	3, 982, 003	+1, 633, 476
Huntingdon	833, 690	839, 613	484, 008	397, 150	757, 678	+360, 528
Indiana	8, 526, 404	11, 414, 048	6, 357, 971	7, 620, 831	10, 475, 299	+2, 854, 468
Jefferson	3, 841, 478	5, 346, 458	2, 707, 894	2, 900, 435	4, 381, 693	+1, 481, 258
Lawrence	140, 054	157, 934	193, 657	208, 907	281, 708	+72, 801
Mercer	481, 521	530, 427	479, 887	457, 453	465, 349	+7, 896
Somerset	10, 433, 752	10, 532, 967	8, 975, 809	7, 628, 253	8, 530, 618	+902, 365
Tioga	593, 637	763, 611	437, 702	374, 154	480, 335	+106, 181
Washington	19, 515, 856	23, 321, 195	14, 716, 984	12, 572, 477	24, 499, 103	+11, 926, 626
Westmoreland	24, 947, 773	24, 510, 146	18, 066, 398	20, 639, 693	25, 408, 870	+4, 769, 177
Small mines	[c] 273, 783	2, 524, 000	([d])	1, 446, 190	238, 957	−1, 207, 233
	150, 758, 154	170, 607, 847	116, 013, 942	113, 148, 308	171, 879, 913	+58, 731, 605
Total value	$365, 430, 504	$642, 630, 000	$322, 538, 300	$351, 777, 000	$472, 217, 000	+$120, 440, 000

[a] Bradford includes Lycoming in 1919; Fulton and Lycoming in 1920; and Fulton, Lycoming, and McKean in 1921.

[b] No production in Cameron in 1919; none in Cameron or McKean in 1920; none in Cameron in 1921; includes Fulton and Lycoming in 1922 and in 1923.

[c] Small mines include Fulton and McKean in 1919; no production in Cameron.

[d] No canvass of wagon mines for 1921.

SOUTH DAKOTA

More lignite was taken from the South Dakota mines in 1923 than in 1922, 10,379 tons, against 7,752 tons, an increase of nearly 40 per cent. The value was $25,000, compared with $22,000, a gain of 13.7 per cent. There were two more men employed, but the men worked 16 days less than in 1922.

The State of South Dakota operates a lignite mine, and the State Coal Mining Commission issues a detailed report on it. The mine is in Adams County, N. Dak., and of course the statistics of output are included in those of the latter State.

TABLE 139.—*Lignite produced in South Dakota, 1922–23*

County	Net tons			Value		Number of employees (underground miners)[a]	Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Total	Total	Average per ton		
1922							
Dewey and Harding	400	930	1,330	$3,400	$2.56	6	154
Meade, Ziebach, and wagon mines	50	887	937	3,600	3.84	5	109
Perkins		5,485	5,485	15,000	2.73	21	140
	450	7,302	7,752	22,000	2.84	32	138
1923							
Dewey and Harding	2,000	325	2,325	6,000	2.58	8	91
Meade and Ziebach		586	586	2,000	3.41	5	75
Perkins		7,468	7,468	17,000	2.28	21	146
Total	2,000	8,379	10,379	25,000	2.41	34	122

[a] Includes also loaders and shot firers.

TABLE 140.—*Lignite produced in South Dakota, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Dewey and Harding	[a] 5,991	6,119	1,891	1,330	2,325	+995
Meade	824	[a] 650	[a] 791	[b] 937	[b] 586	−[b] 351
Perkins	7,602	6,008	4,871	5,485	7,468	+1,983
	14,417	12,777	7,553	7,752	10,379	+2,627
Total value	$45,707	$46,000	$21,200	$22,000	$25,000	+$3,000

[a] Includes Ziebach, no canvass of wagon mines for 1921.
[b] Includes Ziebach and wagon mines in 1922; Ziebach in 1923.

TENNESSEE

More coal was mined in Tennessee in 1923 than in the preceding year, as in most of the other States, but no new record was made. The output was 6,040,268 tons, valued at $16,515,000, an increase of nearly 24 per cent in quantity and about 17 per cent in value.

The number of men employed decreased, but the days in operation increased, and the average daily output per man rose from 2.59 tons in 1922 to 2.93 tons in 1923.

The time lost at the mines during the year was due to dearth of railroad cars and an uninterested market; labor troubles amounted to very little.

The course of daily production in 1923, shown in Figure 58, was remarkably steady.

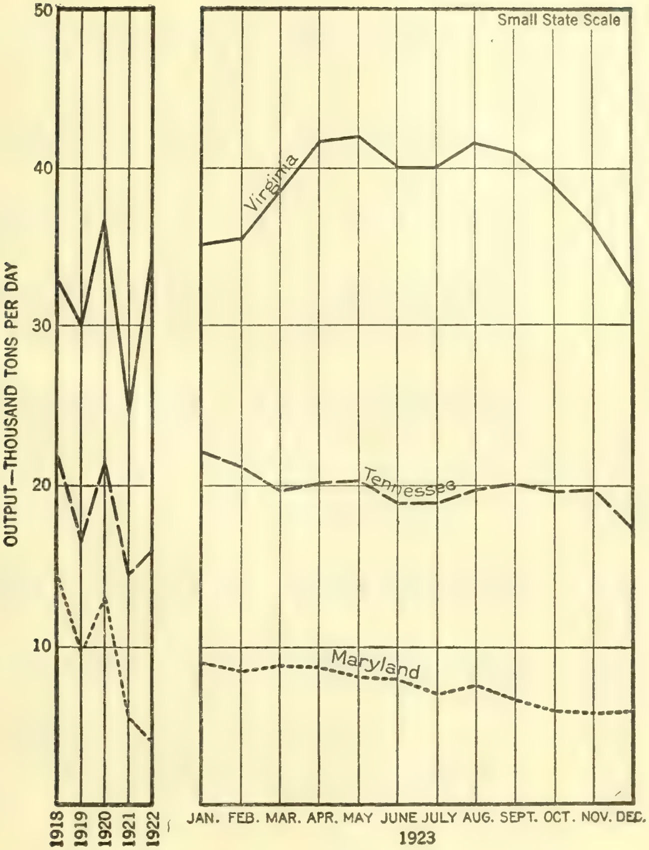

FIGURE 58.—Production of coal per working day in Virginia, Tennessee, and Maryland, 1918–1923. Data from Table 78

TABLE 141.—*Coal produced in Tennessee, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1922												
Anderson	602, 596	8, 802	18, 340	----------	629, 738	$1, 649, 000	$2. 62	708	219	183	1, 110	170
Bledsoe	44, 125	879	1, 000	----------	46, 004	123, 000	2. 67	74	28	10	112	211
Campbell	1, 100, 714	33, 850	21, 919	----------	1, 156, 483	3, 708, 000	3. 21	2, 027	532	417	2, 976	171
Claiborne	627, 309	9, 204	14, 199	----------	650, 712	1, 934, 000	2. 97	789	370	316	1, 475	118
Cumberland	9, 676	174	787	----------	10, 637	48, 000	4. 51	27	15	16	58	69
Fentress	300, 822	5, 703	10, 342	----------	316, 867	860, 000	2. 71	298	99	115	512	153
Grundy	305, 652	1, 075	2, 322	24, 800	333, 849	1, 021, 000	3. 06	815	249	148	1, 212	174
Hamilton	191, 093	8, 385	11, 658	----------	211, 136	617, 000	2. 92	345	163	85	593	157
Marion	189, 736	2, 558	5, 586	----------	197, 880	489, 000	2. 47	287	138	112	537	154
Morgan	306, 418	6, 905	2, 887	----------	316, 210	813, 000	2. 57	436	241	127	804	195
Overton	170, 767	----------	554	----------	171, 321	440, 000	2. 57	184	40	35	259	138
Rhea	59, 448	6, 629	3, 903	----------	69, 980	178, 000	2. 54	175	97	88	360	115
Roane	4, 220	14, 709	5, 347	79, 591	103, 867	294, 000	2. 83	99	86	35	220	239
Scott	136, 983	8, 197	473	----------	145, 653	435, 000	2. 99	206	66	71	343	151
Sequatchie and White	452, 622	4, 907	14, 537	----------	472, 066	1, 310, 000	2. 78	526	194	158	878	188
Total, excluding wagon mines	4, 502, 181	111, 977	113, 854	104, 391	4, 832, 403	13, 919, 000	2. 88	6, 996	2, 537	1, 916	11, 449	163
Wagon mines served by rail	44, 371	----------	----------	----------	44, 371	177, 000	4. 00	----------	----------	----------	----------	----------
Grand total	4, 546, 552	111, 977	113, 854	104, 391	4, 876, 774	14, 096, 000	2. 89	----------	----------	----------	----------	----------
1923												
Anderson	582, 155	9, 694	14, 251	----------	606, 100	1, 419, 000	2. 34	780	283	209	1, 272	161
Campbell	1, 207, 298	37, 253	19, 068	----------	1, 263, 619	3, 798, 000	3. 00	1, 570	615	384	2, 569	188
Claiborne	1, 146, 707	12, 808	17, 987	----------	1, 177, 502	3, 176, 000	2. 70	892	379	238	1, 509	182
Cumberland	16, 870	272	579	----------	17, 721	40, 000	2. 26	26	14	11	51	167
Fentress	346, 218	5, 558	8, 255	----------	360, 031	908, 000	2. 52	290	121	85	496	173
Grundy	445, 614	3, 196	2, 998	52, 979	504, 787	1, 478, 000	2. 93	806	237	207	1, 250	159
Hamilton	332, 314	5, 280	12, 530	----------	350, 124	1, 012, 000	2. 89	357	201	103	661	192
Marion	184, 303	1, 595	5, 636	----------	191, 534	549, 000	2. 87	206	84	61	351	227
Morgan	379, 810	3, 724	10, 372	28, 500	422, 406	892, 000	2. 11	552	275	129	956	186
Overton	177, 562	1, 765	1, 664	----------	180, 991	508, 000	2. 81	203	45	43	291	157
Roane	6, 209	3, 315	6, 895	109, 232	125, 651	416, 000	3. 31	118	133	41	292	235
Scott	139, 783	8, 073	935	----------	148, 791	391, 000	2. 62	249	83	71	403	128
Other counties [b]	638, 174	27, 124	14, 613	----------	679, 911	1, 895, 000	2. 79	703	263	177	1, 143	218
Total, excluding wagon mines	5, 603, 017	119, 657	115, 783	190, 711	6, 029, 168	16, 482, 000	2. 73	6, 752	2, 733	1, 759	11, 244	183
Wagon mines served by rail	11, 100	----------	----------	----------	11, 100	33, 000	3. 00	----------	----------	----------	----------	----------
Grand total	5, 614, 117	119, 657	115, 783	190, 711	6, 040, 268	16, 515, 000	2. 73	----------	----------	----------	----------	----------

[a] Includes also loaders and shot firers.

[b] Bledsoe, Rhea, Sequatchie, and White.

TABLE 142.—*Coal produced in Tennessee, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Anderson	497, 642	620, 089	333, 416	629, 738	606, 100	−23, 638
Campbell	1, 161, 722	1, 281, 787	1, 044, 037	1, 156, 483	1, 263, 619	+107, 136
Claiborne	1, 077, 772	1, 157, 281	848, 025	650, 712	1, 177, 502	+526, 790
Cumberland	41, 917	74, 149	(a)	10, 637	17, 721	+7, 084
Fentress	353, 428	552, 274	394, 894	316, 867	360, 031	+43, 164
Grundy	378, 447	612, 183	386, 764	333, 849	504, 787	+170, 938
Hamilton	(a)	244, 477	(a)	211, 136	350, 124	+138, 988
Marion	384, 058	357, 419	268, 684	197, 880	191, 534	−6, 346
Morgan	375, 448	443, 930	296, 418	316, 210	422, 406	+106, 196
Overton	(a)	(a)	155, 952	171, 321	180, 991	+9, 670
Roane	162, 645	151, 603	(a)	103, 867	125, 651	+21, 784
Scott	100, 455	148, 470	113, 836	145, 653	148, 791	+3. 138
Other counties [b]	678, 066	941, 966	618, 300	588, 050	679, 911	+91, 861
Small mines	1, 605	76, 800	(c)	44, 371	11, 100	−33, 271
	5, 213, 205	6, 662, 428	4, 460, 326	4, 876, 774	6, 040, 268	+1, 163, 494
Total value	$14, 448, 168	$26, 778, 000	$14, 932, 000	$14, 096, 000	$16, 515, 000	+$2, 419, 000

[a] Included under "Other counties."
[b] Bledsoe, Hamilton, Overton, Rhea, Sequatchie, and White in 1919; Bledsoe, Overton, Rhea, Sequatchie, and White in 1920; Bledsoe, Cumberland, Hamilton, Rhea, Roane, Sequatchie, and White in 1921; and Bledsoe, Rhea, Sequatchie, and White in 1922 and in 1923.
[c] No canvass of wagon mines for 1921.

TEXAS

Again Texas mined a little more coal than in the preceding year, but all of the increase came from the lignite fields. The bituminous output was 175,332 tons, which was 89,847 tons, or nearly 34 per cent, less than in 1922, but the output of lignite was greater by 171,169 tons, or more than 20 per cent, making the net gain for the State 81,322 tons, or 7.4 per cent. The value dropped from $2,563,000 to $2,162,000 a loss of $401,000, or 15.6 per cent.

There was a decided falling off in the number of men employed and the days in operation at the bituminous-coal mines, in part because of a seven months' strike at the Bridgeport Coal Co.'s mines; this was partly offset by an increase of both items in the lignite mines. The State, as a whole, showed a decrease of 389 men and 7 days compared with 1922.

TABLE 143.—*Coal produced in Texas, 1922–23*

Kind	Net tons				Value		Number of employees				Average number of days worked
							Underground				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Miners [a]	All others	Surface	Total	
1922											
Bituminous [b]	254,053	2,284	8,842	265,179	$1,342,000	$5.06	1,037	252	140	1,429	190
Lignite [c]	822,542	10,273	8,013	840,828	1,221,000	1.45	957	289	166	1,412	181
	1,076,595	12,557	16,855	1,106,007	2,563,000	2.32	1,994	541	306	2,841	185
1923											
Bituminous [d]	163,436	2,025	9,871	175,332	836,000	4.77	652	141	122	915	131
Lignite [e]	993,465	4,539	13,993	1,011,997	1,326,000	1.31	989	352	196	1,537	206
	1,156,901	6,564	23,864	1,187,329	2,162,000	1.82	1,641	493	318	2,452	178

[a] Includes also loaders and shot firers.

[b] Erath, Maverick, Palo Pinto, Webb, Wise, and Young counties.

[c] Bastrop, Bexar, Henderson, Hopkins, Houston, Leon, Milam, Nacogdoches, Shelby, Titus, and Wood counties.

[d] Erath, Maverick, Palo Pinto, Webb, and Wise counties.

[e] Anderson, Bastrop, Bexar, Henderson, Hopkins, Houston Lee Leon, Milam, Nacogdoches, Shelby, Titus, and Wood counties

TABLE 144.—*Coal produced in Texas, 1919–1923, in net tons*

Kind	1919	1920	1921	1922	1923	Increase or decrease, 1923
Bituminous [a]	734, 087	545, 227	210, 638	265, 179	175, 332	−89, 847
Lignite [b]	946, 569	1, 069, 788	762, 201	840, 828	1, 011, 997	+171, 169
	1, 680, 656	1, 615, 015	972, 839	1, 106, 007	1, 187, 329	+81, 322
Total value	$4, 527, 640	$6, 062, 000	$2, 563, 600	$2, 563, 000	$2, 162, 000	−$401, 000

[a] Includes Erath, Maverick, Palo Pinto, Webb, Wise, and Young counties in 1919, 1920, and 1922; Erath, Maverick, Palo Pinto, Webb, and Wise counties in 1921 and 1923.

[b] Includes Bastrop, Fayette, Henderson, Hopkins, Houston, Leon, Medina, Milam, Nacogdoches, Titus, and Wood counties in 1919; Bastrop, Henderson, Hopkins, Houston, Lee, Leon, Medina, Milam, Nacogdoches, Shelby, and Wood counties in 1920; Bastrop, Henderson, Hopkins, Houston, Leon, Medina, Milam, Shelby, and Wood counties in 1921; Bastrop, Bexar, Henderson, Hopkins, Houston, Leon, Milam, Nacogdoches, Shelby, Titus, and Wood counties in 1922; and Anderson, Bastrop, Bexar, Henderson, Hopkins, Houston, Lee, Leon, Milam, Nacogdoches, Shelby, Titus, and Wood counties in 1923.

UTAH

Utah, New Mexico, and North Carolina are the only States that showed a decrease in the production of coal in 1923. Utah's tonnage loss was the greatest but her percentage loss the least of the three. The output in 1923 was 4,720,217 tons, valued at $13,657,000, a decrease of 271,791 tons, or 5.4 per cent in quantity, and $2,030,500, or 12.9 per cent in value.

The number of employees fell from 4,721 in 1922 to 4,381 and the average number of days worked from 204 to 160.

Figure 46 makes clear the ups and downs of the coal industry in the State in the years 1918 to 1922 and in the several months of 1923.

TABLE 145.—*Coal produced in Utah, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
								Underground				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Miners [a]	All others	Surface	Total	
1922												
Carbon	3, 984, 318	38, 764	94, 149	300, 414	4, 417, 645	$13, 877, 000	$3. 14	2, 054	1, 138	996	4, 188	206
Emery	349, 156	9, 512			358, 668	1, 191, 000	3. 32	138	117	57	312	187
Summit	69, 259	7, 800	1, 070		78, 129	199, 000	2. 54	45	32	17	94	224
Uintah		2, 940	75		3, 015	10, 000	3. 32	6	4	4	14	181
Other counties [b]	126, 999	2, 914	3, 988		133, 901	408, 000	3. 05	59	36	18	113	156
Total, excluding wagon mines	4, 529, 732	61, 930	99, 282	300, 414	4, 991, 358	15, 685, 000	3. 14	2, 302	1, 327	1, 092	4, 721	204
Wagon mines served by rail	650				650	2, 500	3. 80					
Grand total	4, 530, 382	61, 930	99, 282	300, 414	4, 992, 008	15, 687, 500	3. 14					
1923												
Carbon	3, 805, 385	37, 388	74, 105	403, 054	4, 319, 932	12, 511, 000	2. 90	2, 174	970	859	4, 003	161
Emery	246, 797	7, 704	336		254, 837	785, 000	3. 08	132	48	41	221	115
Summit	42, 962	7, 510	691		51, 163	123, 000	2. 40	33	27	18	78	157
Other counties [c]	83, 749	3, 869	6, 267		93, 885	237, 000	2. 52	40	18	21	79	191
Total, excluding wagon mines	4, 178, 893	56, 471	81, 399	403, 054	4, 719, 817	13, 656, 000	2. 89	2, 379	1, 063	939	4, 381	160
Wagon mines served by rail	400				400	1, 000	2. 50					
Grand total	4, 179, 293	56, 471	81, 399	403, 054	4, 720, 217	13, 657, 000	2. 89					

[a] Includes also loaders and shot firers.
[b] Grand, Iron, San Juan, and San Pete.
[c] Grand, Iron, San Juan, and Uintah.

TABLE 146.—*Coal produced in Utah, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Decrease, 1923
Carbon	4, 108, 002	5, 313, 202	3, 701, 641	4, 417, 645	4, 319, 932	97, 713
Emery	335, 054	482, 828	241, 278	358, 668	254, 837	103, 831
Grand	[a] 118, 167	[a] 132, 177	[a] 73, 880	[a] 133, 901	[a] 93, 885	[a] 43, 031
Summit	54, 882	65, 353	58, 171	78, 129	51, 163	26, 966
Uintah	9, 929	9, 228	3, 814	3, 015	([a])	([a])
Small mines	5, 289	2, 411	([b])	650	400	250
	4, 631, 323	6, 005, 199	4, 078, 784	4, 992, 008	4, 720, 217	271, 791
Total value	$12, 760, 613	$19, 350, 000	$13, 662, 000	$15, 687, 500	$13, 657, 000	$2, 030, 500

[a] Grand includes Iron in 1919 and 1920; Iron and San Pete in 1921; Iron, San Juan, and San Pete in 1922; and Iron, San Juan, and Uintah in 1923.

[b] No general canvass of wagon mines for 1921.

VIRGINIA

In 1923 Virginia made her greatest output of coal, although somewhat handicapped by lack of cars in the early part of the year and by a sluggish market later on. The total was 11,761,643 tons, valued at $32,468,000—an increase of 12 per cent in quantity and of about 20 per cent in value, compared with 1922. The number of employees and of days worked also increased.

It is interesting to note the fluctuations in the daily tonnage for the period covered on the chart (fig. 58.) The bottom was touched in 1921, when the average was 24,000 tons. The average for 1920 was 37,000 tons and for 1923 as a whole, 38,000 tons; April, May, and August were the months in 1923 in which the maximum daily output was reached—about 41,000 tons.

TABLE 147.—*Coal produced in Virginia, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1922												
Dickenson	845, 363	10, 375	14, 496	----------	870, 234	$2, 255, 000	$2. 59	354	274	187	815	214
Lee	753, 193	5, 781	3, 331	----------	762, 305	2, 045, 000	2. 68	714	324	252	1, 290	152
Montgomery	32, 634	5, 110	4, 450	----------	42, 194	183, 000	4. 34	65	31	66	162	172
Russell	2, 025, 347	37, 242	7, 985	----------	2, 070, 574	5, 189, 000	2. 51	1, 023	713	553	2, 289	209
Tazewell	1, 508, 525	25, 469	29, 853	----------	1, 563, 847	4, 544, 000	2. 90	926	691	462	2, 079	194
Wise	4, 352, 260	57, 934	28, 460	584, 212	5, 022, 866	12, 205, 000	2. 43	3, 080	2, 460	949	6, 489	205
Other counties [b]	80, 393	14, 443	11, 445	----------	106, 281	435, 000	4. 09	128	74	73	275	132
Total, excluding wagon mines	9, 597, 715	156, 354	100, 020	584, 212	10, 438, 301	26, 856, 000	2. 57	6, 290	4, 567	2, 542	13, 399	198
Wagon mines served by rail	52, 873	----------	----------	----------	52, 873	227, 000	4. 29	----------	----------	----------	----------	----------
Grand total	9, 650, 588	156, 354	100, 020	584, 212	10, 491, 174	27, 083, 000	2. 58	----------	----------	----------	----------	----------
1923												
Dickenson	903, 007	8, 492	13, 530	----------	925, 029	2, 485, 000	2. 69	436	300	216	952	225
Lee	1, 007, 318	9, 735	7, 615	----------	1, 024, 668	2, 726, 000	2. 66	824	487	263	1, 574	188
Montgomery	57, 447	3, 254	10, 656	----------	71, 357	353, 000	4. 95	81	42	42	165	138
Russell	2, 024, 361	33, 243	8, 453	----------	2, 066, 057	5, 392, 000	2. 61	1, 042	706	432	2, 180	205
Tazewell	1, 462, 678	16, 061	14, 136	----------	1, 492, 875	4, 728, 000	3. 16	937	756	405	2, 098	168
Wise	4, 701, 364	125, 872	25, 116	1, 160, 780	6, 013, 132	16, 029, 000	2. 67	3, 384	2, 498	1, 034	6, 916	231
Other counties [b]	126, 983	15, 474	16, 535	----------	158, 992	724, 000	4. 55	106	52	77	235	275
Total, excluding wagon mines	10, 283, 158	212, 131	96, 041	1, 160, 780	11, 752, 110	32, 437, 000	2. 76	6, 810	4, 841	2, 469	14, 120	212
Wagon mines served by rail	9, 533	----------	----------	----------	9, 533	31, 000	3. 22	----------	----------	----------	----------	----------
Grand total	10, 292, 691	212, 131	96, 041	1, 160, 780	11, 761, 643	32, 468, 000	2. 76	----------	----------	----------	----------	----------

[a] Includes also loaders and shot firers.

[b] Chesterfield, Pulaski, and Scott.

TABLE 148.—*Coal produced in Virginia, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Dickenson	472, 059	614, 904	448, 387	870, 234	925, 029	+54, 795
Lee	679, 017	946, 125	687, 928	762, 305	1, 024, 668	+262, 363
Montgomery	44, 081	44, 250	36, 730	42, 194	71, 357	+29, 163
Pulaski	[a] 65, 592	[a] 129, 899	[a] 52, 416	[a] 106, 281	[a] 158, 992	+[a] 52, 711
Russell	1, 801, 607	2, 122, 891	1, 543, 862	2, 070, 574	2, 066, 057	−4, 517
Tazewell	1, 208, 814	1, 323, 712	1, 253, 902	1, 563, 847	1, 492, 875	−70, 972
Wise	5, 049, 436	6, 062, 325	3, 469, 153	5, 022, 866	6, 013, 132	+990, 266
Small mines	6, 224	134, 500	([b])	52, 873	9, 533	−43, 340
	9, 326, 830	11, 378, 606	7, 492, 378	10, 491, 174	11, 761, 643	+1, 270, 469
Total value	$23, 774, 941	$45, 446, 000	$22, 947, 700	$27, 083, 000	$32, 468, 000	+$5, 385, 000

[a] Pulaski includes Scott in 1919 and 1920; Chesterfield in 1921; and Chesterfield and Scott in 1922 and 1923.

[b] No canvass of wagon mines for 1921.

WASHINGTON

The production of coal in 1923 in Washington was 2,926,392 tons, valued at $10,894,000. Compared with 1922 this was an increase of 345,227 tons, or 13.4 per cent in quantity, and of $615,000, or 6 per cent in value, the result of more days in operation, for the number of employees fell off.

The trend of daily production (fig. 51) exhibited the seasonal aspect characteristic of the Northwestern States.

TABLE 149.—*Coal produced in Washington, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1922												
King	658, 250	14, 240	15, 544		688, 034	$2, 708, 000	$3. 93	554	445	260	1, 259	241
Kittitas	991, 753	21, 288	39, 977		1, 053, 018	4, 238, 000	4. 02	1, 239	356	270	1, 865	136
Lewis	165, 186	10, 550	4, 581		180, 317	531, 000	2. 94	165	80	64	309	148
Pierce	246, 064	3, 556	13, 014	41, 025	303, 659	1, 549, 000	5. 10	245	220	171	636	292
Thurston and Whatcom	327, 302	13, 501	11, 584		352, 387	1, 236, 000	3. 51	231	69	112	412	201
Total, excluding wagon mines	2, 388, 555	63, 135	84, 700	41, 025	2, 577, 415	10, 262, 000	3. 98	2, 434	1, 170	877	4, 481	194
Wagon mines served by rail	3, 750				3, 750	17, 000	4. 50					
Grand total	2, 392, 305	63, 135	84, 700	41, 025	2, 581, 165	10, 279, 000	3. 98					
1923												
King	598, 077	28, 118	13, 236		639, 431	2, 225, 000	3. 48	516	385	239	1, 140	218
Kittitas	1, 294, 588	19, 485	43, 934		1, 358, 007	5, 212, 000	3. 84	1, 177	351	284	1, 812	190
Lewis	92, 836	15, 978	4, 974		113, 788	318, 000	2. 79	101	63	50	214	156
Pierce	282, 309	3, 676	14, 681	59, 554	360, 220	1, 653, 000	4. 59	295	281	182	758	261
Thurston	257, 454	3, 796	5, 800		267, 050	801, 000	3. 00	109	35	43	187	241
Other counties [b]	172, 570	9, 828	5, 348		187, 746	684, 500	3. 65	115	32	48	195	250
Total, excluding wagon mines	2, 697, 834	80, 881	87, 973	59, 554	2, 926, 242	10, 893, 500	3. 72	2, 313	1, 147	846	4, 306	213
Wagon mines served by rail	150				150	500	3. 33					
Grand total	2, 697, 984	80, 881	87, 973	59, 554	2, 926, 392	10, 894, 000	3. 72					

[a] Includes also loaders and shot firers

[b] Cowlitz and Whatcom

Table 150.—*Coal produced in Washington, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
King	931, 843	975, 366	341, 546	688, 034	639, 431	−48, 603
Kittitas	1, 310, 386	1, 837, 939	1, 391, 529	1, 053, 018	1, 358, 007	+304, 989
Lewis	134, 490	151, 686	139, 437	180, 317	113, 788	−66, 529
Pierce	355, 104	413, 579	102, 517	303, 659	360, 220	+56, 561
Thurston and Whatcom [a]	258, 624	378, 523	453, 693	356, 137	454, 946	+98, 809
	2, 990, 447	3, 757, 093	2, 428, 722	2, 581, 165	2, 926, 392	+345, 227
Total value	$10, 691, 222	$14, 560, 000	$9, 787, 000	$10, 279, 000	$10, 894, 000	+$615, 000

[a] Includes Skagit 1919–1921; small mines in 1920, 1922, and 1923; and Cowlitz in 1923 No canvass of wagon mines for 1921.

WEST VIRGINIA

West Virginia mined more coal in 1923 than ever before in any one year, forging ahead of her output in 1920, the former record year for the State, and for the first time passing the 100,000,000-ton mark. All the counties of any importance showed gains except McDowell and Mercer, although there were fewer wagon mines in operation. The net increase in quantity, compared with 1922, was 27,411,749 tons, or 34.1 per cent, and in value $49,319,000, or 20.9 per cent. The total output was 107,899,941 tons, valued at $285,481,000.

The average number of days the mines were in operation in 1923 was 169, larger than in 1921 and 1922, but less than in 1918, 1919, or 1920. In no month of 1923 did the average daily tonnage drop to the average level of any one of the five preceding years. (See fig. 59.) Thus against a daily average in 1920 of a little more than 292,000 tons, the daily rate in 1923 ranged from 300,000 tons in February to 398,000 tons in July and August.

The spot prices per ton for smokeless and Kanawha coal for the period 1918 to 1923 are also shown in Figure 59. In January, 1923, smokeless coal brought $5.95 a ton, but it declined almost steadily to $1.97 in December; Kanawha coal began the year with an average price of $3.52 and ended with $1.63.

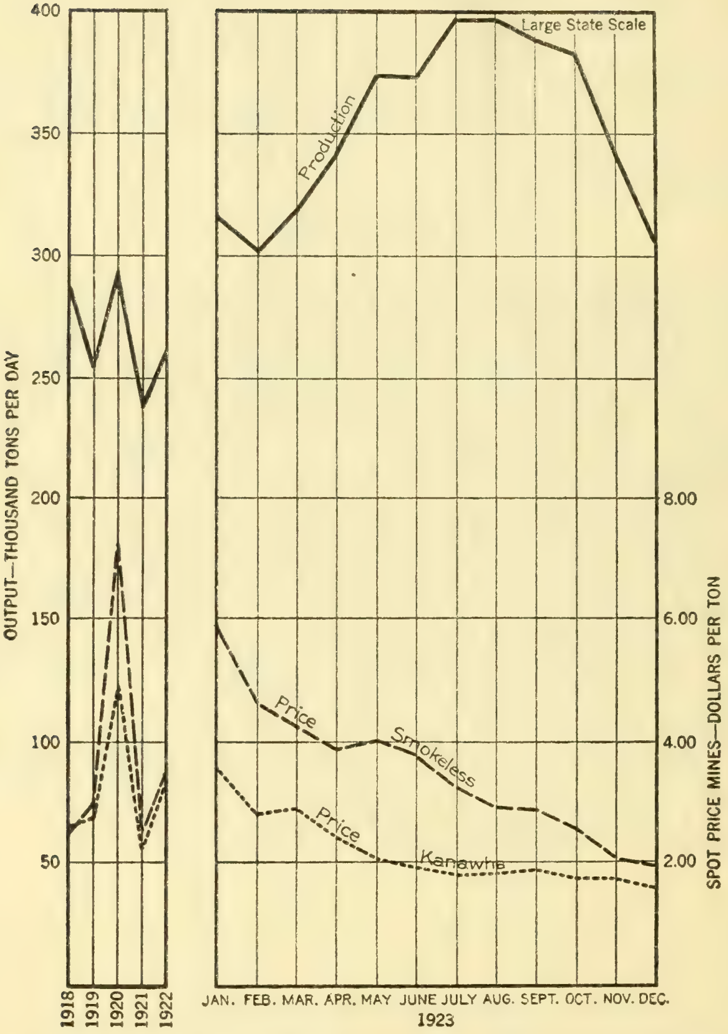

FIGURE 59.—Production of coal per working day in West Virginia and trend of spot prices of smokeless and Kanawha, run-of-mine grades, 1918–1923. Data from Tables 78 and 79; spot prices as quoted by Coal Age

TABLE 151.—*Coal produced in West Virginia, 1922–23*

County	Net tons					Value		Number of employees				Average number of days worked
								Underground				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Miners [a]	All others	Surface	Total	
1922												
Barbour	1, 215, 892	16, 881	13, 130	10, 339	1, 256, 242	$3, 400, 000	$2. 70	1, 560	579	379	2, 518	101
Boone	894, 516	31, 087	9, 811		935, 414	3, 020, 000	3. 23	1, 201	564	413	2, 178	81
Braxton	229, 793	57, 074	6, 769		293, 636	891, 000	3. 03	295	122	84	501	152
Brooke	1, 040, 711	623, 661	214		1, 664, 586	5, 751, 000	3. 45	1, 551	433	251	2, 235	233
Clay	772, 106	11, 981	7, 857		791, 944	2, 250, 000	2. 84	553	258	140	951	187
Fayette	5, 290, 985	158, 198	57, 433	273, 583	5, 780, 199	18, 765, 000	3. 25	5, 894	3, 257	1, 697	10, 848	119
Gilmer and Summers	135, 475	4, 083	6, 385		145, 943	437, 000	2. 99	119	60	35	214	179
Grant	92, 150	755	5, 350		98, 255	297, 000	3. 03	101	41	40	182	206
Greenbrier	434, 715	48, 038	2, 541		485, 294	1, 348, 000	2. 78	288	137	72	497	147
Hancock	9, 585	2, 320			11, 905	34, 000	2. 86	24	5	4	33	78
Harrison	3, 225, 730	153, 064	6, 336	450	3, 385, 580	10, 250, 000	3. 03	4, 041	1, 727	1, 030	6, 798	87
Kanawha	2, 537, 854	74, 809	22, 358		2, 635, 021	8, 923, 000	3. 26	4, 025	2, 041	1, 094	7, 160	76
Lewis	59, 048	20, 830	330		80, 208	258, 000	3. 22	110	38	26	174	104
Lincoln	118, 616	3, 037	2, 077		123, 730	423, 000	3. 41	182	77	69	328	82
Logan	13, 149, 036	231, 504	19, 809		13, 400, 349	37, 555, 000	2. 80	6, 149	4, 613	2, 303	13, 065	179
McDowell	16, 616, 768	226, 401	218, 786	59, 254	17, 121, 209	46, 436, 000	2. 71	7, 192	5, 960	3, 973	17, 125	181
Marion	3, 112, 435	54, 022	86, 590	69, 525	3, 322, 572	10, 542, 000	3. 17	3, 550	1, 751	889	6, 190	101
Marshall	935, 808	415, 195	20, 572		1, 371, 575	4, 567, 000	3. 33	960	413	185	1, 558	179
Mason	26, 741	23, 276	1, 741		51, 758	152, 000	2. 94	122	30	22	174	103
Mercer	3, 289, 167	61, 170	14, 121	75, 049	3, 439, 507	9, 134, 000	2. 66	1, 623	1, 380	755	3, 758	194
Mineral	368, 232	6, 742	6, 732		381, 706	1, 238, 000	3. 24	566	159	139	864	131
Mingo	3, 143, 750	23, 913	36, 878		3, 204, 541	9, 220, 000	2. 88	1, 896	1, 404	847	4, 147	174
Monongalia	4, 426, 907	83, 486	800	30, 621	4, 541, 814	14, 110, 000	3. 11	3, 719	1, 549	930	6, 198	130
Nicholas	238, 786	11, 063	7, 293		257, 142	856, 000	3. 33	282	95	122	499	128
Ohio	1, 146, 187	234, 499	3, 412		1, 384, 098	4, 046, 000	2. 92	1, 329	303	200	1, 832	151
Preston	1, 541, 695	121, 028	19, 431	161, 910	1, 844, 064	5, 712, 000	3. 10	1, 691	723	461	2, 875	147
Putnam	203, 826	2, 372	2, 898		209, 096	820, 000	3. 92	477	263	136	876	102
Raleigh	7, 719, 702	134, 394	68, 561		7, 922, 657	22, 480, 000	2. 84	4, 689	3, 074	1, 793	9, 556	149
Randolph	457, 149	17, 236	10, 768	27, 130	512, 283	1, 602, 000	3. 13	488	151	100	739	131
Taylor	479, 786	9, 478	4, 087	1, 414	494, 765	1, 428, 000	2. 89	838	429	194	1, 461	79

[a] Includes also loaders and shot firers.

TABLE 151.—*Coal produced in West Virginia, 1922–23*—Continued

County	Net tons					Value		Number of employees				Average number of days worked
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Made into coke at mines	Total	Total	Average per ton	Underground		Surface	Total	
								Miners [a]	All others			
1922—Continued												
Tucker	414, 436	7, 702	37, 505	750	460, 393	$1, 581, 000	$3. 43	541	202	81	824	129
Upshur	657, 247	30, 435	7, 351		695, 033	2, 099, 000	3. 03	697	304	173	1, 174	126
Wayne	170, 814	2, 622	623		174, 059	455, 000	2. 62	137	69	75	281	166
Webster	26, 210	5, 759	30		31, 999	91, 000	2. 85	54	9	7	70	137
Wyoming	1, 713, 938	10, 528	560		1, 725, 026	4, 769, 000	2. 76	841	809	481	2, 131	162
Total, excluding wagon mines	75, 895, 796	2, 918, 643	709, 139	710, 025	80, 233, 603	234, 940, 000	2. 93	57, 785	33, 029	19, 200	110, 014	143
Wagon mines served by rail	254, 589				254, 589	1, 222, 000	4. 80					
Grand total	76, 150, 385	2, 918, 643	709, 139	710, 025	80, 488, 192	236, 162, 000	2. 93					
1923												
Barbour	2, 826, 421	35, 546	15, 768	43, 082	2, 920, 817	6, 494, 000	2. 22	1, 866	744	396	3, 006	177
Boone	2, 119, 578	28, 211	14, 384		2, 162, 173	5, 321, 000	2. 46	1, 662	823	537	3, 022	130
Braxton	282, 917	37, 168	6, 948		327, 033	780, 000	2. 39	308	123	78	509	170
Brooke	1, 273, 872	882, 504			2, 156, 376	5, 508, 000	2. 55	1, 239	535	280	2, 054	206
Clay	893, 645	26, 680	10, 347		930, 672	2, 352, 000	2. 53	584	247	202	1, 033	167
Fayette	8, 645, 609	175, 876	65, 975	628, 775	9, 516, 235	29, 198, 000	3. 07	6, 443	3, 759	1, 722	11, 924	157
Gilmer	115, 652	2, 672	3, 713		122, 037	238, 000	1. 95	64	26	21	111	167
Grant and Summers	118, 990	1, 635	6, 706		127, 331	295, 000	2. 32	141	45	69	255	205
Greenbrier	669, 275	53, 874	1, 877		725, 026	1, 739, 000	2. 40	327	175	94	596	179
Hancock	700	2, 892			3, 592	13, 000	3. 62	16	5	3	24	70
Harrison	6, 773, 953	350, 182	10, 476		7, 134, 611	15, 647, 000	2. 19	4, 617	1, 895	1, 110	7, 622	158
Kanawha	5, 671, 369	82, 459	26, 351		5, 780, 179	13, 460, 000	2. 33	4, 892	2, 458	1, 349	8, 699	142
Lewis	52, 923	22, 307			75, 230	170, 000	2. 26	126	46	30	202	112
Lincoln	310, 678	1, 574	1, 753		314, 005	717, 000	2. 28	337	179	99	615	103
Logan	13, 397, 010	185, 720	21, 325		13, 604, 055	34, 115, 000	2. 51	6, 807	4, 493	2, 131	13, 431	172
McDowell	16, 385, 281	170, 176	197, 115	173, 877	16, 926, 449	52, 182, 000	3. 08	7, 154	5, 979	3, 862	16, 995	172
Marion	6, 856, 458	178, 129	104, 529	116, 897	7, 256, 013	17, 226, 000	2. 37	3, 623	1, 984	902	6, 509	202
Marshall	1, 140, 203	555, 882	26, 827		1, 722, 912	4, 312, 000	2. 50	967	391	205	1, 563	232
Mason	65, 129	22, 802	3, 945		91, 876	241, 000	2. 63	132	44	32	208	117
Mercer	3, 112, 493	51, 645	4, 060	70, 739	3, 238, 937	10, 913, 000	3. 37	1, 595	1, 203	767	3, 565	176

Mineral	403, 502	6, 355	3, 781		413, 638	1, 055, 000	2. 55	560	147	142	849	124
Mingo	3, 949, 279	42, 658	33, 574		4, 025, 511	9, 795, 000	2. 43	2, 297	1, 494	871	4, 662	172
Monongalia	8, 308, 773	112, 001	604	70, 672	8, 492, 050	17, 648, 000	2. 08	4, 362	1, 754	918	7, 034	203
Nicholas	252, 556	17, 053	6, 310		275, 919	760, 000	2. 75	284	125	78	487	137
Ohio	1, 991, 160	324, 908	2, 863		2, 318, 931	5, 830, 000	2. 51	1, 165	332	224	1, 721	235
Preston	1, 665, 455	210, 443	16, 378	159, 294	2, 051, 570	4, 746, 000	2. 31	1, 773	728	467	2, 968	161
Putnam	340, 064	2, 651	2, 598		345, 313	1, 178, 000	3. 41	481	196	84	761	155
Raleigh	9, 013, 149	152, 048	82, 622		9, 247, 819	28, 084, 000	3. 04	4, 998	3, 368	1, 627	9, 993	167
Randolph	606, 475	15, 838	14, 923	68, 830	706, 066	2, 214, 000	3. 14	438	131	83	652	148
Taylor	760, 546	6, 958	1, 137		768, 641	1, 599, 000	2. 08	802	294	190	1, 286	108
Tucker	927, 413	7, 844	50, 544	6. 326	992, 127	3, 179, 000	3. 20	768	278	109	1, 155	194
Upshur	932, 047	49, 774	9, 122		990, 943	2, 163, 000	2. 18	698	281	190	1, 169	157
Wayne	195, 191	565	2, 397		198, 153	507, 000	2. 56	139	66	38	243	151
Webster	22, 302	5, 566	12		27, 880	94, 000	3. 37	39	17	11	67	169
Wyoming	1, 812, 638	18, 750	9, 940		1, 841, 328	5, 448, 000	2. 96	972	842	496	2, 310	140
Total, excluding wagon mines	101, 892, 706	3, 841, 346	758, 904	1, 338, 492	107, 831, 448	285, 221, 000	2. 65	62, 676	35, 207	19, 417	117, 300	169
Wagon mines served by rail	68, 493				68, 493	260, 000	3. 80					
Grand total	101, 961, 199	3, 841, 346	758, 904	1, 338, 492	107, 899, 941	285, 481, 000	2. 65					

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[a] Includes also loaders and shot firers.

TABLE 152.—*Coal produced in West Virginia, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase or decrease, 1923
Barbour	1,280,185	1,895,625	1,004,442	1,256,242	2,920,817	+1,664,575
Boone	1,371,552	1,613,709	1,180,108	935,414	2,162,173	+1,226,759
Braxton	381,867	348,017	175,779	293,636	327,033	+33,397
Brooke	1,408,085	1,711,712	1,531,457	1,664,586	2,156,376	+491,790
Clay	462,485	519,364	620,527	791,944	930,672	+138,728
Fayette	8,038,630	9,015,900	6,136,796	5,780,199	9,516,235	+3,736,036
Gilmer	79,532	122,793	[a] 42,491	[a] 145,943	122,037	(a)
Grant	237,985	262,539	155,634	98,255	[a] 127,331	+[a] 5,170
Greenbrier	[b] 132,640	[b] 124,131	144,921	485,294	725,026	+239,732
Hancock	16,378	9,875	3,356	11,905	3,592	−8,313
Harrison	4,824,627	6,053,506	3,767,564	3,385,580	7,134,611	+3,749,031
Kanawha	5,068,925	6,426,044	3,955,219	2,635,021	5,780,179	+3,145,158
Lewis	48,938	73,151	23,440	80,208	75,230	−4,978
Lincoln	186,338	292,415	245,643	123,730	314,005	+190,275
Logan	9,701,320	10,627,263	11,484,117	13,400,349	13,604,055	+203,706
McDowell	16,780,056	16,819,148	13,703,496	17,121,209	16,926,449	−194,760
Marion	4,958,152	5,698,876	4,938,874	3,322,572	7,256,013	+3,933,441
Marshall	954,268	1,251,547	1,092,309	1,371,575	1,722,912	+351,337
Mason	114,353	215,812	69,395	51,758	91,876	+40,118
Mercer	2,709,405	2,692,879	3,161,510	3,439,507	3,238,937	−200,570
Mineral	369,470	621,203	102,144	381,706	413,638	+31,932
Mingo	2,908,794	1,857,471	1,893,723	3,204,541	4,025,511	+820,970
Monongalia	2,522,104	3,792,941	3,839,813	4,541,814	8,492,050	+3,950,236
Nicholas	206,226	293,221	133,200	257,142	275,919	+18,777
Ohio	919,639	1,392,473	1,444,604	1,384,098	2,318,931	+934,833
Preston	1,355,453	2,001,440	687,933	1,844,064	2,051,570	+207,506
Putnam	308,958	339,092	288,330	209,096	345,313	+136,217
Raleigh	6,896,696	7,759,703	7,200,902	7,922,657	9,247,819	+1,325,162
Randolph	859,425	1,029,226	550,001	512,283	706,066	+193,783
Taylor	974,665	1,117,092	516,849	494,765	768,641	+273,876
Tucker	1,075,600	1,189,011	901,297	460,393	992,127	+531,734
Upshur	571,397	727,160	508,974	695,033	990,943	+295,910
Wayne	42,666	67,025	35,259	174,059	198,153	+24,094
Webster	46,728	42,289	20,536	31,999	27,880	−4,119
Wyoming	1,175,435	1,447,054	1,226,353	1,725,026	1,841,328	+116,302
Small mines	47,576	520,000	(c)	254,589	68,493	−186,096
	79,036,553	89,970,707	72,786,996	80,488,192	107,899,941	+27,411,749
Total value	$196,551,015	$390,046,000	$206,661,500	$236,162,000	$285,481,000	+$49,319,000

[a] Summers County included with Gilmer in 1921 and 1922; and with Grant in 1923.
[b] Greenbrier includes Summers and Wetzel in 1919; and Summers in 1920.
[c] No canvass of wagon mines for 1921.

WYOMING

The production of coal in Wyoming rose from 5,971,724 tons in 1922, when the mines of the State were closed for five months by the general suspension, to 7,575,031 tons in 1923, a gain of 1,603,307 tons, or 26.8 per cent; the increase was general throughout the State, as every county reported a larger output. The value was also greater by $2,754,000, or 15.2 per cent.

The mines were in operation 64 more days than in the preceding year but gave employment to 1,500 fewer men. The average output per man per day was 5.23 tons, against 5.15 tons in 1922. The curve of average daily production in Figure 51 shows a marked seasonal variation.

TABLE 153.—*Coal produced in Wyoming, 1922–23*

County	Net tons				Value		Number of employees				Average number of days worked
							Underground				
	Loaded at mines for shipment	Sold to local trade and used by employees	Used at mines for steam and heat	Total	Total	Average per ton	Miners [a]	All others	Surface	Total	
1922											
Albany, Carbon, and Uinta	412, 622	8, 710	20, 426	441, 758	$1, 252, 000	$2. 83	329	173	145	647	140
Fremont, Hot Springs, and Park	590, 590	6, 210	33, 782	630, 582	2, 376, 000	3. 77	492	312	184	988	152
Johnson and Weston	51, 678	18, 551	9, 708	79, 937	253, 000	3. 16	80	45	29	154	137
Lincoln	976, 927	10, 551	50, 314	1, 037, 792	3, 132, 000	3. 02	777	306	266	1, 349	166
Sheridan	775, 635	8, 322	19, 100	803, 057	2, 492, 000	3. 10	956	275	205	1, 436	69
Sweetwater	2, 887, 033	25, 570	52, 409	2, 965, 012	8, 606, 000	2. 90	2, 632	1, 266	573	4, 471	128
Total, excluding wagon mines	5, 694, 485	77, 914	185, 739	5, 958, 138	18, 111, 000	3. 04	5, 266	2, 377	1, 402	9, 045	128
Wagon mines served by rail	13, 586			13, 586	51, 000	3. 75					
Grand total	5, 708, 071	77, 914	185, 739	5, 971, 724	18, 162, 000	3. 04					
1923											
Albany and Uinta	25, 355	9, 752	4, 356	39, 463	114, 000	2. 89	35	6	9	50	218
Carbon	574, 163	6, 725	17, 931	598, 819	1, 793, 000	2. 99	229	167	87	483	211
Converse, Johnson, and Weston	153, 312	8, 938	9, 691	171, 941	546, 000	3. 18	83	47	30	160	245
Fremont, Hot Springs, and Park	591, 896	6, 343	38, 447	636, 686	2, 381, 000	3. 74	388	266	151	805	180
Lincoln	1, 374, 699	11, 884	68, 846	1, 455, 429	4, 250, 000	2. 92	748	333	269	1, 350	262
Sheridan	880, 203	28, 464	7, 931	916, 598	1, 334, 000	1. 45	623	161	140	924	115
Sweetwater	3, 649, 501	25, 461	65, 446	3, 740, 408	10, 454, 000	2. 79	2, 097	1, 040	620	3, 757	183
Total, excluding wagon mines	7, 249, 129	97, 567	212, 648	7, 559, 344	20, 872, 000	2. 76	4, 203	2, 020	1, 306	7, 529	192
Wagon mines served by rail	15, 687			15, 687	44, 000	2. 80					
Grand total	7, 264, 816	97, 567	212, 648	7, 575, 031	20, 916, 000	2. 76					

[a] Includes also loaders and shot firers.

TABLE 154.—*Coal produced in Wyoming, 1919–1923, in net tons*

County	1919	1920	1921	1922	1923	Increase, 1923
Carbon and Uinta	593, 487	744, 596	593, 230	[a] 441, 758	[a] 638, 282	[a] 196, 524
Converse, Johnson, and Weston	[b] 260, 993	264, 806	134, 839	[b] 79, 937	171, 941	92, 004
Fremont, Hot Springs, and Park	732, 213	888, 497	693, 516	630, 582	636, 686	6, 104
Lincoln	1, 310, 949	1, 473, 654	1, 302, 855	1, 037, 792	1, 455, 429	417, 637
Sheridan	1, 422, 145	1, 912, 723	938, 269	803, 057	916, 598	113, 541
Sweetwater	2, 894, 938	4, 338, 995	3, 537, 957	2, 965, 012	3, 740, 408	775, 396
Small mines	5, 013	7, 000	([c])	13, 586	15, 687	2, 101
	7, 219, 738	9, 630, 271	7, 200, 666	5, 971, 724	7, 575, 031	1, 603, 307
Total value	$18, 751, 024	$28, 741, 000	$23, 358, 500	$18, 162, 000	$20, 916, 000	$2, 754, 000

[a] Includes Albany.

[b] Includes Crook in 1919; no production in Converse in 1922.

[c] No canvass of wagon mines for 1921.

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